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SCENES IN MATANZAS, CUBA.

SCENES IN MATANZAS.

MATANZAS, or San Carlos de Matanzas, is a city and seaport on the north coast of Cuba. It lies some fifty-two miles east of Havana, with which it is connected by rail. In times of peace it is to Havana what Philadelphia is to New York. The Havanese run over in the morning and back at night. During the late insurrection in Cuba the railroad between the two cities was probably the most dangerous road in the world to ride upon. It was always being fired upon either by the insurgents or by the Spaniards. The province of Matanzas is the smallest of the provincial districts of Cuba, and covers an area of 3,300 square miles, or a little less than that of the island of Porto Rico. At the beginning of the Cuban war the population of Matanzas province was probably in the neighborhood of 275,000. To-day it is estimated at about 190,000, owing to war and pestilence. The city has from 40,000 to 50,000 inhabitants, and occupies a fine site at the head of the bay of Matanzas. It is separated from its suburbs, Pueblo Nuevo and Versailles, by the San Juan River on the one side and the Yumuri River on the other. From the top of the hill behind the city one overlooks the hill-bordered expanse of the beautiful valley of Yumuri. The harbor has deteriorated on account of mud brought down by the San Juan. The bay is well sheltered from all winds except the northeast, which brings in a heavy sea. Some two and a half miles to the east are the beautiful stalactite caves of Bellemar, about three miles in extent. Our engravings give an admirable idea of the city, the San Juan and Yumuri Rivers. At one time Matanzas bid fair to be the base of operations and supplies in the Cuban campaign, but events finally shaped themselves so that Santiago, and not Matanzas, was the scene of the conflict. But when Cuba becomes a popular winter resort Matanzas will certainly be one of the leading attractions of the island, and nowhere in Cuba is scenery more beautiful than in this city, with its valley and rivers.

Now the streets are clean and well kept, and the wave of cleanliness has also included all the buildings, areas and courtyards which were so filthy under the old regime. Some parts are given a daily sweeping and a rigid system of garbage cans has been introduced, and any infraction of the sanitary law is severely punished. The fortifications would probably not have proved very formidable to our war vessels, for Fort San Severino, one of the principal fortifications, had a small collection of mortars and cannon, none of which was less than forty years old, and for all the damage they could have done the troops could probably have been landed in launches. On the other side of the bay are the famous sand batteries where the historic "mule of Matanzas" was killed.

The chief industry of the district is sugar raising, and the province includes some of the best sugar plantations on the island. In 1894 there were 108 sugar mills, but now, owing to the war, only 42 are in operation. In 1894 the province exported somewhat over 400,000 tons of sugar, about one-third of all that was exported from the island. This would represent a value of nearly $20,000,000, but owing to the lack of cultivation during the war, it is doubtful whether the whole sugar output of the island for 1899 will exceed this amount.

There are 445 miles of railroad in the province, exclusive of private lines on sugar estates, so that it will be seen that the facilities for communication are excellent, and we may look forward to the time when the province will be the most fertile of the entire island of Cuba, and the city of Matanzas will be one of the most prosperous cities.

RELATION OF EXTERNAL AGENTS IN PLANT REPRODUCTION.*

THE closer we study the phenomena of nature, the more apparent becomes the dependency of the various forms of life upon one another; and this is particularly true of the vegetable kingdom. We see various external agents taking part in the reproduction of the species of plants; and in many cases the natural orders have peculiar adaptation in their organs pointing to this end.

The first external agent which we shall consider in this struggle for existence is that of the wind. Many plants, especially among the trees and woody shrubs, are entirely dependent upon this agency for their fertilization. For example: In the large group of trees including the oaks and chestnuts, where the blossoms are in the form of catkins and where the male and the female flowers are borne either on different trees, or different portions of the same tree, we find the wind forming an indispensable agency in carrying the pollen from the staminate, catkin-bearing flowers to the pistillate flowers. An example of this is seen in our common chestnut, which is one of the trees wind-fertilized. The male flowers are borne in long catkins coming into blossom in the early part of July, when the trees are fully in leaf. The female flowers are borne in small clusters at the base of these catkins and do not come to maturity until after the male flowers of their respective catkins have passed the pollen-bearing stage. It will be seen from this how absolutely necessary is the carrying of pollen from the one portion of a tree to another portion, or from one tree to an adjacent tree, in order that the fruit may be produced.

The oaks also show an example of this mode of fertilization; but in this group of plants, although belonging to the same natural order as the chestnut, we find that the flowers come into blossom very early in the season, before the leaves have made their appearance; and this is also true of the beech, which forms another group of this same order.

Another large group of plants entirely fertilized by the agency of the winds is the grasses, also the sedges. In these two groups the anthers are arranged on very slender filaments, and the slightest action of the wind occasions them to vibrate rapidly and the pollen is carried in masses over the blossoming fields in this manner.

Probably the most important, however, of all the agents in the reproduction of plants, are the insect visitants. It has been known for years that plants were dependent, to a greater or less extent, on insects for their fertilization; but how intimately associated certain species of insects were with certain species of plants, has not become known until comparatively recently. We find many instances where species of insects are in evidence only when certain plants are blooming; and, after apparently performing their service in the transporting of the pollen from one flower to another, they entirely disappear.

The floral organs of plants—that is, the corolla, the showy portion of the flower—are specially adapted for the attraction of insect visitants; and we see this exemplified in very many interesting ways. For example, many species of plants which are fertilized by night-flying moths or other insects, have their flowers white, or a pale shade of yellow, so that they are easily discernible in the dim evening light when the insects will be moving around. Again, in many cases we see markings on the corolla to guide the insect into the tube, as it may be, in order to get its load of pollen and transport in this way to another flower; and, still again, we find the arrangement of the corolla such as to entrap the insect visitant until the pollen has been shed and it can then carry its load away to another flower, where the pistil is in a receptive condition, and is again held prisoner until after the stamens have shed their load of pollen, when it is released to go through the same operation with another flower.

Perfume is also another important agent to this same end for the attraction of the insect visitants; and this is particularly true of the night-blooming species of plants. It is invariably the case that they are more or less strongly scented.

One of our earliest plants to come into flower in the springtime has peculiar adaptation for this same purpose, the common skunk cabbage. The odor of this flower (which is of a very pungent and somewhat fetid nature) proves attractive to a small species of carrion beetle, which is the agent by which the plant becomes fertilized. When the flowers commence to blossom the pistils are first protruded and, as a matter of course, many of these first-flowering plants bring no seed to maturity; as it is impossible that they should get pollen to fertilize them. Some days later the stamens are protruded, at which stage the insect visitants are always present; as, at the first opening of the flower, the pungent odor becomes more pronounced. The insects will remain for days at a time around the base of the flower-bearing spadix and thus become thoroughly covered—legs, under surface of the body, and back—with the pollen grains, which are shed very profusely. After the pollen has been shed, the pungent odor dies away and the beetle then starts in quest of fresh fields, and in this way carries pollen to a newly opened flower, when the pistil is in a receptive condition, thus enabling them to produce their quota of seed. In the flower of the common iris is shown one of the arrangements for the attraction of insects (and apparently without any other functional properties) in the hairs which thickly clothe the lower lip of the corolla. These hairs are simply for the guiding of the insect and are bright orange in color and, oftentimes, will become pollen-dusted from the insect visitants from another plant. The iris bears but a single stamen under each of the three floral portions; and the insect visitant gets the shower of pollen upon its head and back. Later, in its subsequent visits to another flower, where the stigma has become in a receptive condition and is bent down, this pollen, so acquired, is brushed on to the stigmatic surface, thus insuring the fertilization of the flower.

In our common mullein we find another arrangement to insure the fertilization, in the peculiar arrangement of the stamens in respect to the pistil. At the time that the flower is opened the pistil is not in a receptive condition; and as the insect visiting the flower commences at the bottom of the spike, working upward, it brings its load of pollen from some other plant and deposits it on the pistils in the receptive condition; and by the time it gets to the top of the spike it has received another load of pollen from the newly opened flowers, and carries this away to transfer it to the developed pistils at the base of another spike of the flowers of the same species.

One of the most interesting forms that we have in this section showing the arrangement for retaining the insect as a prisoner until after the pollen has been shed, is in one of our vines, the Aristolochia clementitis, an introduced species, closely allied to the Virgina snake-root. This plant is not uncommon in some of the old fields around Philadelphia—especially around Bartram's Gardens, and in some places through Delaware County, Pa. Here the corolla consists of a long tube with numerous hairs pointing downward. The flower is fertilized entirely through the agency of small flies. These can easily enter the long tube of the corolla, being attracted by the unpleasant odor of the flower and further by its peculiar reddish-green color. The flies, coming into the corolla, have no difficulty at all in getting down the tube; but they cannot get out until after the pollen has been shed. The anthers are located in the lower portion of the flower; and the fly will wander around at the base of the corolla tube until after the pollen has been copiously shed, when the hairs which have held the prisoner become limp and shrivel up on the side of the tube, when the fly is released and immediately visits another flower. In this particular case the pistil is in a receptive condition before the pollen is shed; so that it is impossible for the flower to be fertilized by its own pollen, as the stigmatic surface is entirely dried up before the pollen-shedding stage is reached. The fly, after receiving its load of pollen from this newly visited flower, visits still another which is not so fully advanced and with a portion of its corolla erected and acting as a sort of a banner to attract the fly, and it thus deposits its load of pollen on the stigma which is waiting ready to receive it, and is then held prisoner again until after it has received still another load of pollen.

Many flowers, as previously stated, show mechanical arrangements for the shedding of their pollen; and this is particularly true of the order Ericaceae. One of the most noticeable and interesting of these mechanical arrangements is seen in the flower of our common Laurel; and it may be stated here that in all cases the mechanical arrangement is seen in the stamens—the retention of the anthers, as a rule, in pockets in the corolla, they being displaced by the slightest pressure. In the case of the laurel the bud shows the peculiar pocket-like arrangements for the fastening of the stamens around the corolla. These little pockets in the sides of the corolla retain the anthers very firmly, the filaments being bent at a considerable tension. An insect visiting the flower and pressing down on its surface immediately releases the stamens, and, as before stated, there being considerable tension on the filaments, the stamens are quickly thrown forward, thus ejecting through the end of the anthers the pollen on the lower surface of the insect. Another peculiarity of all the plants in this order above referred to is in the method of the opening of the anthers. It is invariably at the end—two openings; and the pollen grains are held together in long beadlike strings. It can be readily seen from this that an insect, visiting such a flower and receiving its load of pollen as it flits around over the head of blossoms, will come in contact with a flower further advanced than the others, where the pistil is in a receptive condition; and as this is always more or less glutinous at the tip, it leaves behind it a certain portion of these pollen beads which are suspended from its legs and the lower surface of the body. A similar arrangement to this we see in one of the small species of Huckleberry, and this is entirely fertilized by a small species of bee. The flowers in this particular instance are drooping; and the little bee visitant coming to the flower will thrust its head into the open corolla when it immediately receives a shower of pollen in its face; rather rude treatment, as it would seem, from a flower which is absolutely depending on this small bee for its fertilization. This, however, is apparently in no way distasteful to the little worker; as it will persist in visiting flower after flower, and in many cases, of course, succeeds in fertilizing some of the more fully developed flowers with the showers of pollen which it has successively received upon its head.

Another adaptation in an allied species is found in our common Rhododendron maximum, as well as in the various species of Azalea which are more or less common in our woods through the spring and summer. In these, the stamens have long filaments and curve upward; the insect visiting a flower is attracted, in the case of the rhododendron, by the spotting of the throat of the corolla, and in quest of the nectar which is secreted at the base, presses down on to these protruding stamens. This slight pressure is enough to release the pollen, which is thrown upward on to the lower surface of the insect; and, as in the case of the laurel, it will fly away with long strings of pollen grains hanging to its legs and lower surface of the body. These flowers are fertilized almost entirely by the little day-flying humming-bird moths. These moths will be seen to flutter very lightly in front of the flower and, in getting in to get the nectar, press against the stamens as above described and get their load of pollen. The pistil does not develop until after the stamens have shed their pollen, when it is also protruded in the same general position as the stamens; and the insect visiting the flower with its load of pollen grains, is sure to leave some behind on the glutinous stigmatic surface.

One of the most interesting groups of plants which we find especially adapted for insect fertilization is that of the Orchids. In these we find numerous arrangements; but in most of our native species, at any rate, they are provided with what are known as polliniæ, two organs, one on either side of the throat of the corolla, bearing the stamen grains. These polliniæ have at their base small, glutinous cushions; and as the organs themselves are borne in small pockets at the mouth of the corolla tube, and these glutinous cushions protruding, an insect visitant, probably a small moth, in protruding its head and proboscis into the corolla tube to receive the nectar, presses tightly against these two surfaces and, in withdrawing the head, it withdraws the polliniæ from the pockets in which they are retained and will fly away with them fastened tightly to the side of the head, oftentimes on the eyes.

The stigmatic surface in most of our Habernaria, at least, is borne around the upper portion of the corolla tube; and the insects visiting a flower in quest of honey, after having received a pollinia from another flower, are sure to press these polliniæ attached to the head against this stigmatic surface, thus transferring a certain portion of the pollen to it and thus fertilizing the flower; and, in leaving the flower again, if it has not already had an insect visitant, it will carry away a fresh pair of polliniæ to, in turn, fertilize another flower of some adjacent plant. In our common Orchis spectabilis—the Showy Orchid—one of our common species blooming in the middle of May, through rich woodlands, we find a similar arrangement to that existing in the Habernaria, which has already been described.

The external agents are not only active in the reproducing of seed, but also in their distribution. I will now refer briefly to arrangements which we have for distribution of seed by the agency of the wind. Common examples of these may be seen in our Maples, all of which are provided with winged seeds; in the common Ailanthus; in the Ash; and in many other species of trees; in the Milkweeds and nearly all of the plants of the Compositæ, the seeds of which are furnished with attachments which enable them to be readily borne about by the agency of the wind.

Animals are very largely responsible, also, in the transportation of seeds; and many seeds have special adaptation for this purpose, being furnished with hooks, barbs, etc., by which they will adhere to any passing object, in that way insuring their transportation from place to place. Examples of this sort are seen in the Spanish needles, Beggar's lice, our common Tick trefoils and many other common plants.

The plants themselves have many mechanical arrangements, also, for the distribution of seeds; and this is seen in the case of our common Wild Geranium, the Herb Robert (a species common in the mountains and northern woods). Another plant belonging to this same group—the little Wood-sorrel—shows another peculiar mechanical arrangement for the dissemination of its seed; and, strangely enough, still a third in the Touch-me-not, so common along our streams, where a mechanical arrangement exists in the receptacle for the dispelling of the seed upon the slightest pressure or touch.

Again, many plants have adaptations for distribu-

* A lecture by Stewardson Brown, Conservator of the Botanical Section, Academy of Natural Sciences, of Philadelphia. Delivered at the academy, March 24, 1899. Revised by the author.

tion by such agencies as birds; for example, the Cherries and many other fruit-bearing trees and shrubs of this character; and a very pretty example is that of the common species of Magnolia, where the brilliant red seeds are held suspended on delicate threads so that they will be readily seen and can be easily detached by a visiting bird, thus insuring the distribution of the plant over wide areas.

Water is also an important agent in the transportation of seeds, not only by the water itself, as in the case of our river systems, but also through the agency of the birds, which, in their migrations, follow these natural lines of flight. This is very nicely shown along the Susquehanna River, where many species of northern and southern plants are intermingled—the northern plants having been transported there through the agency of the spring and summer freshets and the southern species by the agency of the birds traveling northward in their spring migrations. Here we see one of the southern species of magnolia—the Magnolia umbrella—which has undoubtedly been introduced through the agency of the birds in their migration; and its most northern limit is attained along this river some ten miles below Columbia, where the plant is abundant in the ravines along the river shore, its white trunk and large leaves giving quite a tropical aspect to the woods. The numerous small islands which abound through the lower portion of the Susquehanna River form radiating places for the lodgment and distribution of seeds of plants brought from above by the freshets; and at McCall's Ferry, at the portion where the natives of the region say "the river turns on its edge," we see many northern plants, notably some of the mountain species of pine and laurels, rhododendrons, growing in considerable abundance and luxuriance. At this particular point the river is but a few hundred yards in width; while some fifteen miles above, at Columbia, the river stretches out to a mile or more from shore to shore; and this particular point is yearly one of the places where the river gorges in its spring ice freshets. The small ponds which are also abundant along the river bottoms are occupied with plants both northern and southern in their origin, as well as those which belong naturally to this region; and these are undoubtedly introduced in the ways above referred to, either by the agency of the birds or by the freshets in the spring and summer, when they become a part of the river channel.

EARTHWORMS.

By M. C. HOLMES.

EARTHWORMS, our little friends of the garden, field, and meadow land, play a far more important part in the earth's history than we would suppose. We know them as timid little creatures, unprepossessing in appearance, that live in burrows in the ground which they rarely ever leave in the daytime, yet the work which they accomplish is stupendous, while their life, habits, and structures are filled with great interest.

Earthworms consist of from one hundred to two hundred cylindrical rings or segments, the dorsal surface of which is of a brownish red color, slightly iridescent, while the ventral surface is lighter in color and more iridescent. These segments are furnished with bristles or setae, also called locomotor spines, which are arranged in four longitudinal rows along the ventral surface, two rows where the dark dorsal shades off into the light ventral, and two along the ventral surface near the median line. A small lens is necessary to see these setae, but they can be easily felt by rubbing the fingers along the body of the worm from the posterior to the anterior end. The first segment is not a complete ring, but forms a projecting lobe or lip. The succeeding rings are complete and alike as far as the ninth segment. The ventral portions of the ninth, tenth, and eleventh segments are thickened to form white glandular prominences. Segments twenty-nine to thirty-six form the girdle, and from the thirty-sixth they decrease in width to the posterior extremity of the body.

The body cavity, except in the posterior segments, contains a milky fluid consisting of coagulable albuminous plasma which contains a number of transparent granular corpuscles, also a great many foreign bodies, broken setae, parasitic infusoria, etc.

Very imperfectly separating the body into cavities uniting with the integument, and surrounding the digestive tract, are the muscular partitions or diaphragms.

The digestive tract is a nearly straight tube extending along the median line of the body from the anterior to the posterior end. (This is illustrated in Fig. 1, which shows its dorsal surface, while Fig. 2 represents the digestive tract alone, showing the ventral surface.) First we have the pharynx (Fig. 2 *a*), a broad muscular organ extending from the second to the seventh segment. From the pharynx radiating muscular fibers extend outward, binding it to the integument. At about the third segment are the supra-esophageal ganglia, two pear-shaped bodies on the dorsal surface of the pharynx (Fig. 1 *a*). The esophagus is a thin-walled tube from about the eighth to the sixteenth segments (Fig. 2 *b*). At the tenth and eleventh segments are vascular pouches or glands (Fig. 2 *c*) which secrete carbonate of lime, called calciferous glands and esophageal glands. These glands aid in the process of digestion, it is thought, by extracting from the food which worms eat any lime it may contain. At about the sixteenth segment is the crop, a muscular organ (Fig. 2 *d*). Succeeding the crop is the gizzard, a firm-walled cylindrical chamber (Fig. 2 *e*). Following the gizzard is the intestine, which passes to the posterior end of the body (Fig. 2 *f*). The walls of this organ are very much folded or sacculated, especially in the anterior portion, its dorsal surface is covered by a layer of brownish green glands called hepatic glands, these are very delicate and easily ruptured. They also surround the dorsal bloodvessel as far forward as the esophagus.

The dorsal bloodvessel extends along the digestive tract in contact with its walls, but as a distinct vessel, from its posterior end to the anterior end of the esophagus (Fig. 1 *f*), where it divides into smaller vessels which ramify upon the pharynx. It also gives rise to small lateral vessels which supply the muscular partitions, integument, and digestive organs. Its main trunk dilates and contracts at intervals, but no part of it is modified to form a special pulsating organ.

The nervous system is very well developed. The cerebral ganglia are situated on the dorsal surface of the pharynx (Fig. 3 *a*). From each half of the cerebrum a nerve may be traced forward which divides into smaller nerves that pass to the anterior segments (Fig. 3 *b*). From the outer portion two commissures (Fig. 3 *c*) pass outward and downward around the pharynx, forming the esophageal collar and uniting with the ventral nerve chain. From this collar four or five nerves supply the pharynx, also a number of nerve fibers branch off to the muscles of the fourth segment (Fig. 3 *d* and *e*). The ventral nerve chain consists of two commissural cords side by side in contact from the fourth to the last segment. Along this chain at each segment are ganglionic enlargements (Fig. 3 *g*). In each ganglia posterior to the third a pair of nerves originates supplying the muscles and viscera of each segment (Fig. 3 *h*). In the commissures anterior to the ganglia arise a pair of nerves which pass to the posterior face of the muscular partitions.

The anterior portion of the body is very sensitive; for instance, if the anterior portion is shaded, rays of light may be concentrated on the posterior without producing any effect, that is, the worms will not retreat into their burrows or show any signs of uneasiness, but concentrate the rays of light on the anterior portion, and a rapid retreat is the result.

Worms are destitute of eyes, but can distinguish between darkness and light; in fact, they are very sensitive to light. Suddenly bringing to bear on them the light of a lantern caused them to rapidly retreat into their burrows. Making the light to gradually shine on them caused uneasiness, sometimes retreat, though not generally. The light of a candle in most cases caused a retreat, but sometimes only produced restlessness, in which case the worms would raise the anterior portion of their bodies from the ground and wave it gently to and fro. The sudden lighting of a match caused them to quickly retire into their burrows.

Worms are more sensitive to light than to different degrees of heat. They were indifferent to the heat of a red hot piece of iron when it was held quite near their bodies, though at times when it was only held near enough to allow a slight degree of heat to be perceptible they would immediately withdraw into their burrows. A lighted match, when its light did not alarm them, could be held so near their bodies as

they became restless and uneasy, appearing more so when the ammonia was near. No doubt this uneasiness was caused by the irritation of their skins produced by the ammonia and turpentine; however, when cabbage leaves were placed in the pots they were soon discovered, and when buried in from one-eighth to a quarter of an inch of soil, were discovered and removed. In burying the leaves, when the soil was watered and tightly pressed down over them they were not discovered, evidently because the compactness of the soil prevented the escape of any odor from the leaves.

The sense of taste is remarkably well developed, as worms seem to prefer one article of food more than another. They are fond of cabbage leaves, but seem to care more for half decayed leaves than for fresh ones. Bits of cabbage leaves and celery leaves were placed in the pots; the celery was first eaten, and a greater quantity of it consumed. Half decayed and fresh cabbage leaves and celery were put in; the half decayed leaves were first eaten, the celery next, while the fresh leaves remained untouched for some days. Bits of onion and celery leaves were given them, and the former were first eaten. Half decayed cabbage and celery leaves were placed in the pots with bits of onion; the onion was first eaten, the others remaining untouched for some time, and then the celery was first attacked. Leaves of the carrot and beet were put in together and the carrot was preferred. Carrot and half decayed cabbage and beet leaves were given them and the carrot was still preferred. Bits of raw meat that were buried in the pots were soon discovered and eaten, then bits of fresh and putrid meat were put in; the putrid meat remained untouched, while the fresh bits were soon consumed. Bits of fresh meat and fat were placed in the pots; by one set of worms the fat was preferred, by the others the fresh meat. Worms seem to have a decided preference for certain foods; they are fond of celery and onion, but seem to care for carrot leaves more than all others. The leaves of the wild cherry also form a very desirable article of food, in some cases preferred even to carrot leaves.

With reference to their mental qualities there can be very little said; they are timid, and no doubt suffer pain when injured; they certainly enjoy the pleasure of eating, and seem to possess some social feeling, as they do not mind coming in contact with each other,

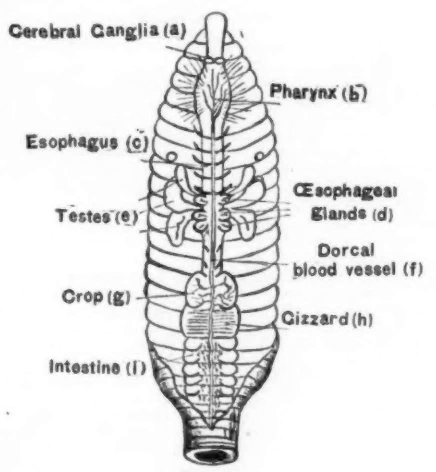


FIG. 1.

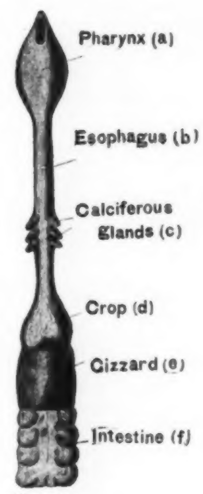


FIG. 2.

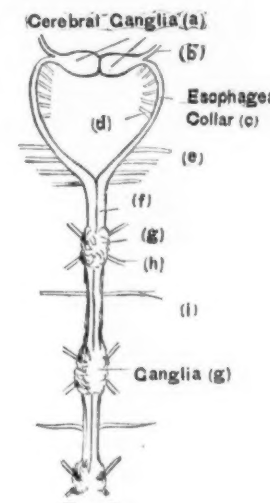


FIG. 3.

almost to burn them without producing any effect. Hot candle grease dropped on their bodies caused instant retreat. Finding a worm out of its burrow in the daytime and concentrating the sun's rays on it through a lens at first produced no effect; in a few seconds it became restless and uneasy, and after about three-quarters of a minute had elapsed the worm beat a very rapid retreat. Pouring hot water on them did not in most cases disturb them; when it did, the disturbance was doubtless caused by the annoyance of having water poured on them, and not by its heat.

Worms do not possess the sense of hearing, as they were indifferent to shouting, whistling, and the shrill notes of a tin horn. In shouting, unless care was taken not to allow the breath to strike them, they would quickly retreat.

They are very sensitive to the vibrations of solid objects. The pots containing the worms were placed on a table, and the table was gently tapped with a ruler; this alarmed them, causing an immediate withdrawal into the burrows. Their perception of vibrations is certainly acute, as in this case they had to be transmitted through the saucers under the pots, through the bottoms of the pots and the soil in them before reaching the worms. Sometimes walking across the floor near the table on which the pots were kept caused a retreat. Rubbing the fingers up and down on the sides of the pots alarmed them, causing instant withdrawal. It has been said that when the ground is beaten worms will crawl out, thinking they are pursued by a mole. I have beaten the ground many times, but have not found this to be the case; even in digging for worms, unless the earth is disturbed beneath them, they will not crawl out of their burrows, but down into them.

Earthworms are extremely sensitive to contact; a light puff of breath from the mouth caused an instant retreat, while gently fanning them caused retreat in most cases. Holding the face near them and breathing in an ordinary manner on them always made them uneasy, and when this was kept up for any length of time caused them to enter their burrows.

The sense of smell seems to be confined to those odors belonging to articles used by them for food. They were indifferent to the odor of cologne when cotton pellets saturated with it were held near them. They were also indifferent to ammonia and turpentine, though at times, when the cotton pellets saturated with these fluids were held quite near their bodies,

and in cold weather a number of them will be found rolled up together in a ball at the bottom of the burrows. They also have some idea of comfort, as they line their burrows with small stones and leaves; this is done no doubt to prevent their bodies from coming in direct contact with the damp, cold earth.

Worms instinctively plug up the mouths of their burrows with leaves, stones, and loose earth. The exact reason for so doing is doubtful. Darwin gives three: first, to prevent the entrance of water during heavy rains; but then he says, "It may be urged against this that a few well rounded stones are ill adapted to keep out water." Then these plugs may aid in concealing the burrows from animals that prey upon the worms, so they can more safely remain with their heads near the mouths of their burrows, a thing which they are very fond of doing. Or it may be these plugs are for the purpose of checking the free ingress of the lower stratum of air when chilled by radiation at night. Darwin inclined toward this latter view, first, because worms kept in pots in a warm room where cold air could not enter the burrows plugged them up in a slovenly manner; second, because worms often line the upper part of their burrows with leaves so their bodies will not touch the cold earth. But it may be possible that this plugging process serves all three purposes; however, worms dislike leaving the mouths of their burrows open. During the autumnal and winter months these plugged burrows may be particularly noticed, as during the warm weather worms reopen the burrows, often failing to close them for a long time, sometimes leaving them open until fall, but generally closing and reopening them several times during a season.

During the daytime worms rarely ever leave their burrows, unless they are sick or during the pairing season, but they come out at night, however, generally remaining with their tails inserted in the mouths of their burrows, into which they quickly withdraw when in any way alarmed. Sometimes they leave their burrows entirely, as may be seen by the worm tracks leading from them; these tracks are particularly noticeable when the ground is moist. It will be observed that these tracks always lead from the burrows and never back to them, consequently it is inferred that when worms once leave their burrows they are unable to find their way back again and must make new ones.

The great number of worms found dead after heavy

rains it has been thought were drowned in their burrows, but this does not seem obvious, as a number of worms kept in a pot containing rather dry soil soon died, while those which were kept in a pot entirely submerged in water lived. These latter worms threw up a great many castings, plugging their burrows with these castings alone, as no leaves were given them which they could use for that purpose; certainly these burrows at all times contained water. So the drowning theory does not seem correct; it is more likely, as Darwin has suggested, the worms were already sick, and flooding the ground only hastened their death. One thing was noticed in regard to the worms kept in the water, the dark dorsal surface became very light in color and quite transparent. When these worms were removed and placed in a pot containing black mould, they eventually became quite dark in color and lost the transparency gained while in the water.

Worms have two ways of excavating their burrows, by swallowing the earth and by pushing it away on all sides by means of the pharynx. The latter is the usual way employed by them for this purpose; they push the thin anterior end of the body into a little hole or crevice in the ground; this acts like a wedge; then push forward the pharynx, which expands and pushes the earth away on all sides; in this way a worm placed on loose mould will bury itself in less than five minutes. When the mould is compact, the excavating is done slowly, and when very compact the burrows are made by means of swallowing, and then the process involves, not minutes, but hours.

Worm burrows are quite deep, extending down several feet below the surface; they generally run perpendicularly, though sometimes are slightly oblique, ending in an enlarged chamber which is sometimes lined with withered leaves and often contains tiny stones and plant seeds. The sides of the burrows are lined with a layer of fine earth ejected by the worms which has become hard, forming a cement, thus making the walls quite firm. A great quantity of earth is swallowed by worms as food; they extract from it any nutritious matter it may contain, and after the food matter is extracted eject the earth, forming the well known worm casting. A great many castings are formed when worms deepen the burrows, as the further down they go the more compact the earth becomes, and the excavating must then be done by means of swallowing.

In ejecting these castings worms perform their great work in the formation of our well known vegetable mould. They have played a prominent part in the burial of old buildings, and have been the means of preserving many ancient objects, such as stone implements, arrowheads, etc. This subject is fully detailed by Darwin in his "Vegetable Mould and Earthworms." Certainly worms can cover objects in a remarkably short time; of course my observations in this matter have been restricted to small objects buried by worms kept in confinement. A small piece of wood one inch square and a little more than an eighth of an inch thick was buried by two rather small worms in four days. A large geranium leaf was buried in six days, and after the seventh more than half of the stem was covered. Worms can throw their castings quite a distance; this of course depends on the condition of the soil; if moist, the castings are ejected in little spurts, when dry the ejecting is done slowly and with a spiral movement. Two worms in a pot containing an umbrella plant which was kept in a glass bowl, the edge of which extended two inches beyond the edge of the pot, would eject their castings with such force as to throw them beyond the edge of the bowl on to the table on which the plant stood. The earth in this case was very moist and therefore easily ejected.

The idea that worms injure plants does not seem to me a correct one, as in every case in which pots containing growing plants were tenanted by worms the plants were not at all injured. It was noticeable that when the soil in the pots was kept clear from withered leaves the surface soon became covered with castings, showing that the worms were subsisting on the nutritious matter contained in the earth, while in the pots where leaves were allowed to remain very few castings were ejected, the worms using the leaves for food. This certainly would indicate that worms do not gnaw the roots of plants.

AUTOMOBILES IN PARIS.

On Easter Sunday (April 2, 1899) the first installment of automobile cabs was placed at the disposal of the Parisian public, says Consul-General Gowdy, of Paris. As soon as they issued from the depot at Aubervilliers, they were eagerly sought after, and gave most satisfactory results. The number of these vehicles is daily being increased, and the Compagnie Générale des Voitures expects, after a month's trial, to be in a position to judge of the convenience or drawbacks of the present type of cabs. Impressions of the wood cuts of the two types at present in use I inclose herewith. These vehicles are provided with accumulators enabling them to travel from 60 to 80 kilometers (37 to 49 miles) without recharging the batteries.

The tariff varies according to the number of persons. For one or two passengers, the ordinary cab fare is applied, viz., 1·50 or 2 francs (28·9 or 38·6 cents) per hour; for three persons, 2 francs the journey; and four persons, 2·50 francs (48·2 cents). Between 12:30 and 6 A. M. the rate is 2·25 or 2·50 francs (43·4 or 48·2 cents) the journey; and 2·50 to 2·75 francs (48·2 to 52·8 cents) per hour, according to the number of passengers. Fares beyond the fortifications will be 25 centimes (4·82 cents) above the existing rate for ordinary cabs.

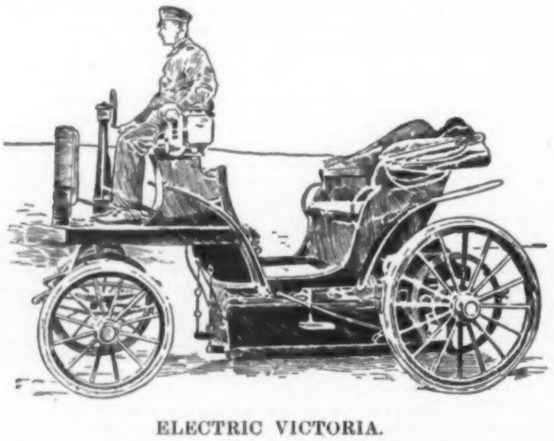
The eventual adoption of automobiles for general use in Paris, as well as throughout France, seems to be a foregone conclusion; but there is no doubt that the tremendous speed at which private individuals with their motor tricycles and other experimental automobiles dash about the streets has had a tendency to discourage the adoption of automobiles by those who would otherwise make purchases.

By daily observation in Paris, it is easy to see that improvements are constantly being made in doing away with the objectionable odors, excessive vibration, and noise.

The action of the Compagnie Générale des Voitures in establishing the speed of its automobiles in the city at about 8 kilometers (5 miles) an hour will diminish, if not avoid, the crushing of pedestrians and serious accidents. The element of fear being eliminated, the introduction of reliable, and not too complicated, mechanism will certainly produce a new era in locomotion throughout France.

I may state that an important and appreciated merit in the new automobile cabs is the brake placed in the interior of the vehicle, by which the passenger can not only check the speed, but bring the conveyance to a standstill independently of the conductor.

In order to have the trial complete and obtain the consensus of public opinion, registers are placed at each cab stand for such observations as individuals may see fit to make. It is the intention of the company to daily increase the supply of vehicles, as may be justified by the demands of the public.



ELECTRIC VICTORIA.

ELECTRIC BROUGHAM.

THE WEHNELT INTERRUPTER FOR INDUCTION COILS.

The X rays and wireless telegraphy have opened up a wider domain for the applications of the Masson and Ruhmkorff induction coil, the use of which up to present years has been limited to laboratory experiments and to the ignition of explosive mixtures in gas motors.

But the fact must be admitted that, in all the apparatus hitherto constructed, the interrupter has been the weak point, it having often proved inadequate to draw from the coil the power and the maximum tension that the apparatus was capable of giving. It is well known, in fact, that the object of the interrupter is to convert into an interrupted current the continuous one that would traverse the primary wire of the coil, if such an apparatus were not used. Numerous mechanical systems have been devised for obtaining frequent and rapid interruptions, and among these may be mentioned tremblers. Unfortunately, tremblers giving frequent interruptions do not produce rapid ones, and those that produce rapid ones do not furnish them with sufficient frequency. In such cases the coil is not well utilized, since the interruption of slight rapidity reduces the secondary tension, and that of slight frequency allows a relatively lengthy period of time to elapse between the successive sparks.

Such inconveniences have made themselves particularly felt in radiography through an increase in the time of exposure, and in radioscopy through furnishing macled images upon the fluorescent screen. So manufacturers and radiographers were putting their wits to work to devise some mechanical arrangement or other to remedy such inconveniences, when Dr. A. Wehnelt, a scientist of Charlottenburg, Germany, in inventing the electrolytic interrupter to which his name will henceforward remain attached, gave investigators an ideally simple and practical apparatus which is destined rapidly to supplant all others.

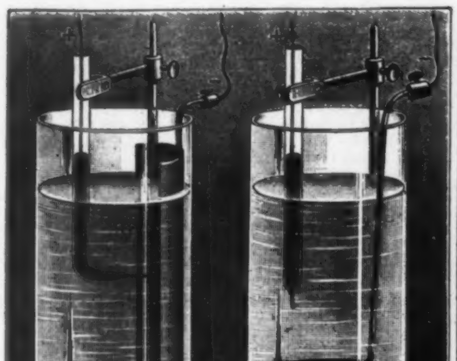


Fig. 1.

Fig. 2.

Fig. 1.—The Wehnelt Electrolytic Interrupter. Fig. 2.—The D'Arsonval Arrangement for Currents of Great Frequency Applied to a Small Induction Coil Operating with the Wehnelt Interrupter.

Fig. 1 represents two very simple forms of this interrupter. Into a glass vessel containing acidulated water of a density of from 1·1 to 1·2 degree enter a plate of lead connected with the negative pole of the electric source and a glass tube filled with mercury to the extremity of which is soldered a platinum wire that projects a few millimeters from the bottom. The mercury is connected with the positive pole of the source by means of a copper wire that enters it; and in the circuit thus formed is interposed the primary circuit of an induction coil (the trembler of which has previously been prevented from operating) and an interrupter for opening or closing the circuit.

In another arrangement (represented to the right in Fig. 1) the plate of lead is replaced by a bath of mercury a few millimeters in thickness into which enters an insulated copper wire bared at its extremities in order to form a contact with the mercury and a terminal. The tube may be straight or may contain one or two bends (in order that the platinum point may be directed upwardly) without the operation of the interrupter being modified by such arrangements. The source with which the coil is connected may be a battery, a series of accumulators, or a sector with continuous or alternating currents. The difference of potential may vary between 20 and 120 volts (our experiments have not gone beyond that) without the interrupter ceasing to work, provided that, between the self-induction of the primary circuit of the coil, the length and diameter of the platinum wire and the electromotive force of the source, there be certain relations of which the numerical values are as yet fixed only by tentatives.

When the proportions are well established, we observe, as soon as the circuit is closed, a violaceous halo around the platinum wire, hear a sharp strident noise

proceeding from the interrupter, and witness an abundant disengagement of gas in the electrolytic liquid and a true torrent of flames between the extremities of the secondary wire. In blowing upon this flame, which is hot enough to ignite paper, the spark becomes stratified, thus showing that the phenomenon is not continuous, and that the flame is made up of a series of frequent sparks that dart into the air heated by the previous ones.

By way of illustration, we may say that in some experiments made at the laboratory of electricity of the School of Physics and Industrial Chemistry of the city of Paris, M. Hospitalier employed what is called a "6 cm. spark" Carpentier coil and obtained therewith sparks of a length of 15 and even 18 cm. with a frequency which, estimated by a revolving mirror, varied between 1,400 and 1,500 a second. The primary circuit was supplied by a battery of 50 accumulators mounted in tension, and the platinum wire was 0·8 mm. in diameter and projected 8 or 10 mm. from the glass tube.

The same Wehnelt tube was used by M. Hospitalier for reproducing some experiments with currents of great frequency by means of Dr. d'Arsonval's greatly simplified arrangement shown in Fig. 2. Here the condensers are formed of two Saint Galmier bottles nearly full of water and the surface of which is covered with tin foil for about a third of the height.

A simple copper wire wound into a spiral causes the water to communicate electrically with the secondary circuit of the coil. The explosive distance of the oscillating discharge is regulated by moving the bottles, the corks of which support two horizontal brass rods 3 mm. in diameter. The circuit of great frequency is formed of a solenoid of copper wire from 5 to 6 mm. in diameter resting upon sheets of tin foil prolonged under the bottle, the whole being placed upon an insulating table or upon a plate of glass. All the experiments of Tesla and d'Arsonval may be simply and effectively reproduced with a coil which would prove inadequate with all the tremblers known.

We advise those of our readers who would like to repeat these very simple experiments to use as large a vessel as possible for the interrupter, in order to prevent a too rapid heating of the liquid, unless they have it in their power to cool the latter by a circulation of water.

The object of the mercury in the Wehnelt tube is to cool the platinum through conductivity by increasing its surface of contact. The same result may be obtained by soldering the platinum to a coarse copper wire insulated through its entire length. For feeble currents and small coils the platinum rods of discarded incandescent lamps constitute a capital positive pole for the Wehnelt interrupter.

We shall not undertake to give an explanation of the theoretic operation of this curious apparatus, a point upon which opinions are as yet very much divided. Experiment has proved that the interrupter will not operate any longer if the self-induction of the circuit be inadequate, and that the frequency diminishes with the increase of self-induction and increases with the tension of the current. We have here, therefore, a very complex phenomenon in which the condenser of variable capacity (formed of the gaseous envelop that surrounds the positive electrode) and the self-induction of the circuit play the leading parts. The heating of the wire has no direct action, as was at first thought, since, when the self-induction of the circuit is too feeble, the platinum wire reddens and remains red, while the current has merely a very feeble intensity and keeps at a constant one.

It remains for us to say merely a word as to the present and future applications of the Wehnelt interrupter. We already see that they will be numerous, aside from laboratory experiments and lecture courses. Radiography and radioscopy are now using the apparatus for reducing the time of exposure and giving a remarkable stability to the images upon the fluorescent screen. Wireless telegraphy will not fail to utilize the greatest frequencies that the system permits of obtaining. Gas motors, and particularly water-gas motors, in which ignition is difficult, will, through the use of it, have a hot spark that will surely prevent any failure to ignite.

This interrupter will permit of forming a very simple and practical electric soldering apparatus which city clockmakers and jewelers may easily use by connecting an appropriate transformer with the circuits that distribute electric energy. Physicians will have the same resource at their disposal for their Crookes tubes without being obliged to have recourse to a transformer or to accumulators.

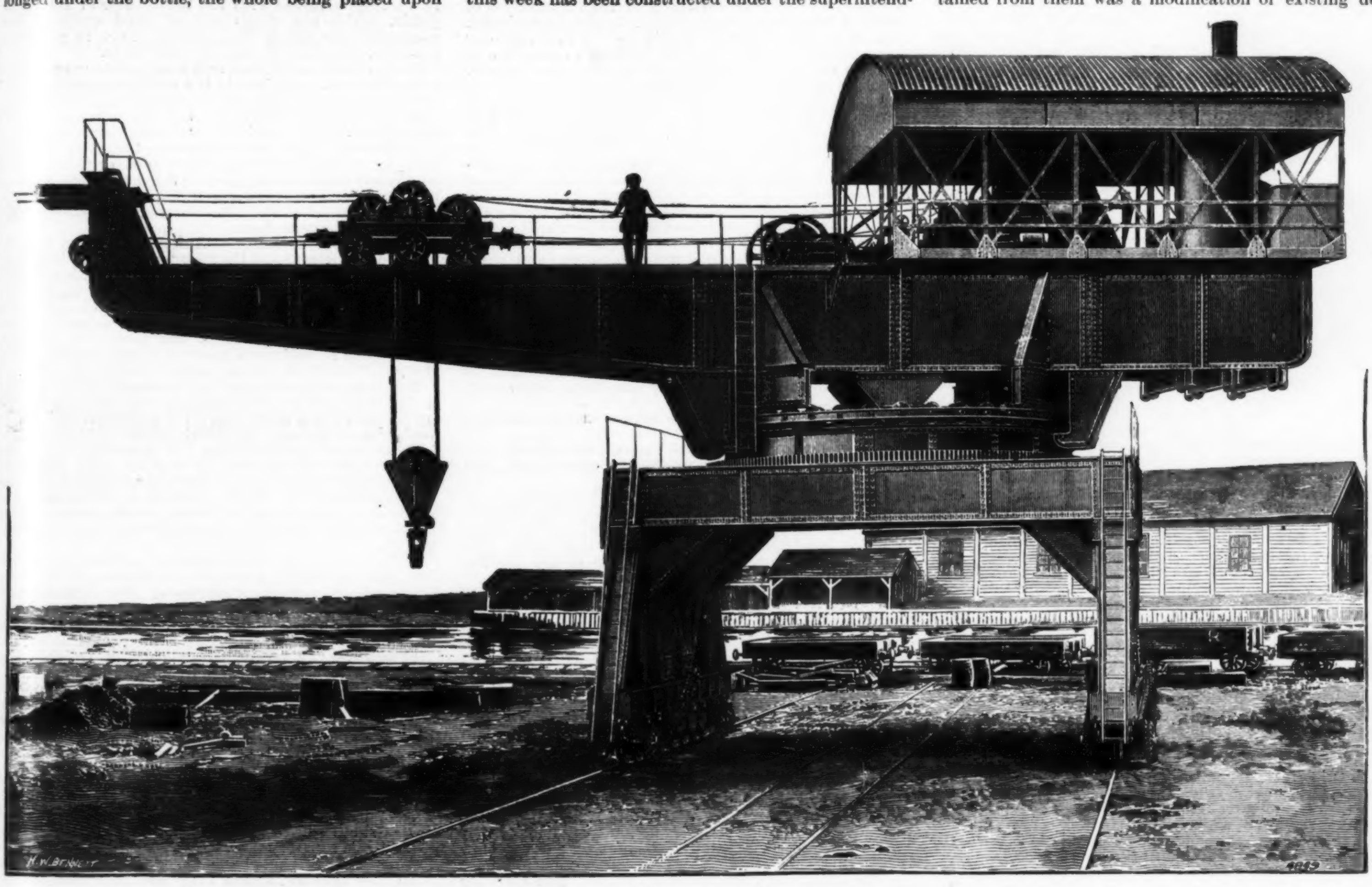
Should it become possible to illuminate vacuum tubes occasionally for producing cold light, the Wehnelt interrupter will suggest itself for the production of the frequency necessary for this method of lighting.

Other applications will be found, since the question is a new one, and no one knew the Wehnelt interrupter three months ago.

For the above particulars and the illustrations, we are indebted to La Nature.

THIRTY-THREE-TON BLOCK-LOADING TITAN CRANE.

THE block-loading titan crane which we illustrate this week has been constructed under the superintendence of Messrs. Coode, Son & Matthews, of Westminster, for Colombo, by Messrs. Cowans, Sheldon & Company, Limited, Carlisle. It is capable of lifting, lowering, racking out and in, and revolving a complete circle, and traveling with concrete blocks of 33 tons each. The titan is mounted on sixteen wheels fitted with volute springs, the centers of the rails on which it runs being 28 feet 6 inches apart. The whole of the framing is of Siemens-Martin steel, all the girders being of box section. The superstructure is carried and revolves on cast steel live rollers, rolling on a steel pathway, turned on its face. Pitch chains are used for driving the traveling wheels, the sprocket wheels for which are of cast steel. The engines and gearing for all motions are placed on the top of the superstructure, with all handles conveniently arranged for the attendant, who also has perfect control of the load by means of Matthews' patent hydraulic brake, with which the crab is fitted. The titan was tested at the makers' works with a load of 42 tons, and the speeds of all motions were well over those specified.—Engineering.



THIRTY-THREE-TON BLOCK-LOADING TITAN CRANE.

AMERICAN MACHINES IN ENGLAND.

FOREIGN engineering publications are devoting a great deal of space to descriptions of American works and products. It is seldom, however, that one finds so outspoken a tribute to our industrial supremacy as that recently printed in Engineering, as part of an article describing the Victoria Works at Sheffield. The article says:

"Before dismissing this subject we will venture to add a few words, even at the risk of becoming tedious, and certainly of saying something which must prove unpleasant. We must preface what we are about to say by stating that Mr. Laycock is an Englishman; in fact, he is a Yorkshireman, which a good many people think is the most English sort of Englishman. Although his inclination and sympathies are entirely toward the country in which he was born and brought up, he has been obliged to go across the Atlantic not only for nearly all the special tools needed in his works but also for a great deal of the material which he uses. This is not from inclination; and, indeed, Mr. Laycock constantly laments the necessity of spending money out of his own country. In regard to machine tools of the class used in these works, there is no need to say much to engineers; the lesson has been too well rubbed in of late by practical experience. The case of the cock-making machinery here described is a typical case in point. At first, as stated, ordinary engineers' lathes were used; then the representative of a well known German firm came along and offered to design and supply special machinery guaranteeing a substantial saving on the old method of manufacture, acceptance and payment depending on the promise made being carried out. This machinery was made and delivered, and proved a substantial advance on the old methods; then a representative of Messrs. Pratt & Whitney offered to go one better, guaranteeing a further considerable saving, again making the fulfillment of the guarantee a condition of the contract, and the result has been so eminently satisfactory that it has paid to discard the German machines; and, indeed, the American tools paid for themselves in a very short space of time.

"It was not that the British toolmakers did not have a chance. They were not only encouraged, but invited to compete; but the most that could be obtained from them was a modification of existing designs which have been standard for very many years past. That, however, refers to machinery; in material Mr. Laycock has had the same experience. The brass rod he uses comes from America, because it is cheaper, and not only of equal quality, but decidedly better than that which can be bought at home. American iron castings, especially malleable castings, are better and cheaper than those which can be got here; the deliveries are more regular, and when a new part is needed, it can be obtained from across the Atlantic more expeditiously and with greater certainty that it will be what is required than is the case if it is ordered in England.

"There is one thing to be said in excuse for British machine toolmakers in this connection, and perhaps this will be best explained by a simple statement of fact. Not very many months back the representative of an American firm, celebrated as designers of automatic labor-saving machine tools, put certain suggestions before the principal of a large firm of brass finishers in this country. As a consequence the firm determined to remodel a part of their system of production, substituting automatic machines for the old primitive methods of hand labor. The arrangements were all settled, and, we believe, orders actually given, when the matter came to the knowledge of the workmen, who intimated that if these machines were introduced they would go out in a body. The firm did not care to enter on a contest with their men, and the orders were canceled."

TOBACCO-SEEDS are so minute that it is said a thimbleful will furnish enough plants for an acre of ground.

GERMAN IMITATIONS OF AMERICAN MACHINE TOOLS.

SINCE the time American machine tools came to this continent on a scale of some importance, a larger demand for tools of increased capacity and greater accuracy was observed in almost all lines. This demand still prevails, and the manufacturers must make special efforts to reach the high standard of many lines of American origin.

In several cases these efforts led to very satisfactory results, but on the other hand, I regret that I experienced something which I might term degeneration of the technical spirit. It would be bad patriotism were I to deny that we have many expert machine designers and builders, but I only object to that kind of "machine designing" which is now practiced by several even prominent shops, and consists of buying the machine to be "constructed" from America, either direct or through an agent, taking it apart, having drawings and patterns made, and, in short, imitating it down to each screw and pin. Such a course is in no case profitable to the original builders, nor in many instances to the final user.

Everyone who once designed a new machine experienced the difference between theory and practice. Many a machine might run like clockwork in the drawing or even when actually built up for testing. Yet it might afterward prove to be a complete failure when put to actual use in another shop. A great deal of money and brains are bestowed upon it, and yet it does not "fill the bill." Sometimes some improvements based on suggestions from operators will make the machine meet the requirements, but in many cases only several years will bring it some steps nearer the required standard.

A great number of prominent machine tool builders on this continent advertise their tools as being built on American plans. This means they improved their regular patterns to the best of their knowledge, adopting some American ideas of "how to do it." Nobody could say anything against this if it is done in a fair way, but the competition referred to above could not be called fair.

It seems to be but a matter of course that every one who attempts to imitate a certain machine tries to do a little improving on it, and if he does not find anything to do, he puts in a little more weight here and a little less there, or replaces a worm gear by a bevel gear, or anything else which in his own opinion might give a little feature in addition to those the machine already possesses. This seems to be but human nature. Now one could say that in very many cases such an "improved" machine fully resembles a previous stage of the original construction, and that it shows anything but an improvement; in some parts even just the reverse.

This is what I desired to point out. If any one is in the market for a special machine tool that he finds to be in competition with its imitation, he should fully and thoroughly investigate both machines, and it seems to me very doubtful whether in many cases the imitator will secure the order. People say that the genius is honored by imitation, but in business affairs this does not count.

American manufacturers will find perfect legal protection in all the European countries where such imitations could be expected. The patent laws of the principal industrial countries afford protection, and manufacturers should not spare the cost, which is not too high, to have their improvements thoroughly protected. A few machines that they will sell in preference to foreign imitations will be sufficient to indemnify them in every respect.—German Correspondent of The Iron Age.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Sulphate of Copper in France.—The approach of the wine-making season has caused the agriculturists in this part of France to unite in a movement for the repeal of the tariff on sulphate of copper, which is extensively used to protect the grapevines against black rot and mildew. In periods of heavy rains, the vines sometimes require five treatments, at an aggregate expense of from $2 to $2.50 per acre. The use of copper has increased, and is expected to further raise the cost of the sulphate; hence, the movement for a reduction of the duty.

As the United States is the largest copper-producing country in the world, a résumé of what is said on this subject in France will not be without interest, says U. S. Consul Covert, of Lyons. The imports of the sulphate into France were:

	Tons.
1895	24,641
1896	34,539
1897	30,909
1898	31,468

The metal base enters into the composition of the sulphate in the proportion of 26 per cent., the price of the sulphate being entirely governed by the price of copper.

When the proposition was made to remove the tariff of 3 francs (57 cents) per 220 pounds from copper, it was stated that an American syndicate had cornered the market and that the corner must soon break, with a resulting fall in prices. Wine growers, influenced by this report, refrained from laying in a supply of sulphate, and as the demand for that article ceased, manufacturers stopped producing. A legislative commission appointed to investigate the subject reported the advance in price to be a legitimate result of the workings of the law of supply and demand, to wit, the new and increased uses of copper in machinery, the extension of telegraphs, telephones, electric lighting and electric tramways, and especially the building of the Metropolitan Trolley Railroad in Paris, which will consume 5,000 tons of copper. The opinion was expressed by the commission that the demand for consumption will continue in excess of production; that Japan and Spain cannot increase their output; that Chile can increase hers; but that the possibility of equalizing the two factors—supply and demand—must depend upon the copper producers of the United States.

The consumption in France amounts, annually, to 60,000 tons—47,000 tons in block, bars and plates; 8,000 tons of old metal, all imported; and 5,000 to 6,000 tons of old copper picked up at home.

The committee of the Lower House of Parliament reported adversely to a reduction of the customs duty. It declared that France was powerless to lower the price of copper, as it does not produce that metal. It is believed here that much of the copper that enters France from England is the production of the United States. It is entered as English goods, so as to escape the extra warehouse tax levied upon merchandise that is transshipped from the country of its origin to France. It was stated in the report of the commission that if the duty were abolished, English dealers would at once raise the price of copper.

The customs tariff on copper yields a revenue of 90,000 francs ($17,370) per year.

Postal Money Order Service with British Honduras.—Consul Avery, of Belize, under date of April 20, 1899, says:

On April 1, the system of interchange of postal money orders between this colony and the United States went into effect. To send a money order from Belize to any city in the United States has required from twenty-five to thirty days. While the money was paid here, the order was issued from London, upon the receipt of mail advices from this post office, and then sent to the receiver in the United States. There is no bank in the colony, and merchants disliked to sell drafts for less than $15. Even by registered mail it was difficult to remit, for United States bills are scarce; but now, the safe and convenient system of direct orders has been adopted, with the usual charge for different amounts.

Trade Conditions in Australasia.—The marked improvement which has obtained in the importation of goods of American manufacture into the Australasian colonies has been due primarily to the fact that our manufacturers have taken the trouble to consult and consider the requirements of the Australian importers, and have maintained a uniform standard of quality and finish in their goods, and have made few alterations in prices. In instances where quality has been deliberately varied and prices have been advanced, on the supposition that the market has been "corraled," the results have been disastrous to the exporters, and have had a reflex action on manufacturers in similar lines of business.

That these colonies present a vast opening for the introduction of our goods is evidenced by the fact that more than half of the agricultural implements imported are of American manufacture and origin, and those which are manufactured in these colonies are copies or travesties of the originals from the States. I propose to briefly review some of the goods which are imported into Australasia, says United States Consul J. P. Bray, of Melbourne.

Canned Meats.—In spite of the local canning, there is a large demand for American meat, which should be encouraged and stimulated by judicious advertising and efforts.

Baking Powder—Made in this country and of good quality.

Oils and Kindred Lines.—The United States has practically controlled this market for many years, and apparently will continue to do so.

Fish.—The canned article from the Pacific slope has absolute command of the salmon trade. The British exports are competing strongly in other lines. There is a very good opening here for tinned and other lines of fish, as the exigencies of the climate in the tropical lands cause an extensive consumption of these goods.

Hardware.—It is a fact that most of the household articles used in this country are imported from the United States, simply on account of their cheapness and adaptability. In heavy lines, Sheffield and Wolverhampton, and once in a while Germany, continue to hold their own in edge tools and engineers' and blacksmith' hammers. Carpenters' tools are entirely from the United States.

Farm and Garden Implements.—These are of American origin, and as long as they are neatly produced and the price is kept within reasonable limits, the United States will continue to fill Australian wants in this direction.

Axes.—These are all of American production, and are likely to remain so, if the quality is kept up to the present standard; but the action of some of our manufacturers in making a cheap ax at a very low price will, if not checked, have a deleterious influence on the trade and provoke competition. The Swedish makers are already doing their best to compete with the American ax, and as soon as they get a little more experience, will become formidable rivals. The fact remains, however, that so far they have to get their handles from the United States.

Saws.—Persistent advertising, combined with cheapness and good quality, have succeeded in making the product of an American firm easily the favorite. The firm referred to is being very closely run by other American competitors, who are getting a proportion of the trade. America will control the market for handsaws. Circular saws, however, are still recognized as having their origin in Sheffield, and the Sheffield trade-mark is usually a guaranty of good quality. A Philadelphia firm is making strenuous efforts to gain the trade. The Sheffield people have been losing ground lately, owing to competition and reduction of quality to meet prices; but good makers are maintaining price, quality, and reputation.

Builder's Ironmongery.—The manufacturers of the United States get a considerable proportion of the trade, and with the exception of brass foundry works, will maintain this position. The brass foundry is imported almost entirely from Birmingham, and this trade will probably never be disturbed.

Locks.—In first-class heavy locks, Great Britain maintains its position, but in padlocks, the United States has the trade. Rim locks and mortise locks are imported from the United States, but not in the same proportion as from Great Britain.

Bird Cages.—These are almost entirely of United States manufacture.

Pumps and Windmills.—Pumps are almost all of American manufacture, except steam pumps, in which British manufactures still hold first position. Windmills are all American.

Stoves.—America had at one time all the trade in portable cooking stoves; but Scotland has made a desperate attempt to recover prestige in this class of castings, and is more than partially successful.

Woodenware.—The United States controls this market; and so long as our manufacturers maintain their standard of excellence, they need fear no competition.

Furniture.—For high class American furniture, there is comparatively little demand; but for cheaper lines, such as desks, chairs, and bureaus, there is an increasing outlet. When once our manufacturers realize the difference between the climates and the necessity of adapting their goods to the requirements of the warmer Australian countries, they will have the market. Meanwhile, China and Japan have an important trade with Australia.

Carriages and Buggies.—The demand is not increasing, simply by reason of the excellence of the local production, though all the parts necessary to the equipment of a first class carriage or buggy are imported from the United States.

Engineers' Tools.—This trade is being steadily developed, and the United States is eclipsing the European market.

Boots and Shoes.—The excellence of the American manufacture is universally admitted, and those makers who are turning out lasts to meet Australian requirements are deriving profit. But this industry is essentially a colonial one, and, in time, Australasia will produce all she requires in this line.

Lamps.—The United States has all the cheap trade now, and for better class goods the demand is increasing every day. A little attention to the style of British productions would enable our manufacturers to supply the whole of Australasia.

Pressed Glassware.—The United States controls this line for nearly all Australasia, but it will be long before we can compete with the better class of European goods, which are cheap and of good quality. Our manufacturers ought to make an effort to gain this business, especially in the cut glass trade.

Cotton Goods.—Denims and heavy cloths are finding a market here, and Canada is a strong competitor with Great Britain. There is an excellent opening here for American cotton cloths, but our manufacturers must find exactly what is wanted, and meet the market.

Underwear.—Cotton underwear finds no demand here, for climatic reasons; but woolen or union goods would sell readily if adapted to the Australian requirements, which are essentially different from the American. Combination suits, for instance, should be "fashioned," and have no legs.

Pig Iron.—The quality of American pig iron has left little to be desired, and that Australia will in the future be a great market for the American production cannot be doubted. But Great Britain has the supremacy, owing to the fact that her iron is exported to Australia with a freight rate of about 60 cents a ton of 2,240 pounds, while the American has always to pay full rates. The British get a nominal freight rate, because the iron is used for ballast, usually for timber ships.

Bar Iron.—America has this business in her hands, if she will maintain her quality and keep down the price. The quality of one or two recent shipments which have reached these markets has been so irregular that merchants are "shy" of American iron until tested. Only refined iron is desired, and the price must be kept below that of the British until a reputation is established. There seems to be a tendency to advance prices recently to British limits, which cannot be done yet, as the United States product is not so well known.

Steel.—American steel is cheaper and frequently better than the British, owing to the better quality of the ore used for conversion purposes. For crucible cast steel, Sheffield will keep to the front for years to come, but for open hearth and Bessemer steel, America can have all the trade, if she gives it the proper attention.

Freights.—The recent irregularity in freights has given rise to a great deal of trouble, and some uncertainty. They must be maintained uniform, and the advent of steamers into this trade will be of great benefit to American exportation. While freights ought to be remunerative to shippers, it is sincerely to be hoped that competition will restrain them from the extravagant rates persisted in by the recent shipping ring.

Banks.—Australian people cannot understand why no American bank has yet opened a branch here. The enormous amount of exchange with the United States should have induced some of our capitalists to exploit this territory

American prospects have never been brighter here than they are now, and a little less independence on the part of some of our manufacturers—notably the nail industries—and a little more regard for local requirements, will lead to a widely increased volume of trade. It must, however, be remembered that in all the seven colonies forming the Australasian group, there are only 5,000,000 people, and, consequently, too much in the way of results must not be expected by our manufacturers, who are beginning to consider the possibilities of Australasia as a field for exportation.

Increase in Venezuelan Tariff.—Minister Loomis cables from Caracas, May 19, 1899, that the new tariff law of Venezuela, by which the president is empowered to add 25 per cent. additional to all duties, will take effect probably in thirty days.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

ELECTRICAL NOTES.

It is stated by Dalziel that from sixty to seventy new electric cabs of the laudau type were recently put on the Paris streets, and were well patronized by the public. About 100 more will be shortly brought into use.

Workmen of the Metropolitan Street Railway Company unearthed in Fulton Street, New York, the other day, the remains of an old trolley slot, recalling the fact that on that street the underground trolley system had its first trial more than fifteen years ago. The Bentley-Knight system was used on Fulton Street for several months.—Electrical Review.

The first electric tramway in the Dutch Indies has been opened in Batavia, Java. It has been built by the Union Elektricitäts Gesellschaft, of Berlin, for a Dutch company. The population of Batavia is 130,000, and, says the Elektrotechnisher Anzeiger, the street traffic is considerable. The length of the line is 9½ miles. An interesting feature is that, out of deference to the magnetic observatory in the neighborhood, a double trolley system has been employed, the rails carrying no current.

A pretty reading lamp is made with a nautilus shell for a shade. The shell is mounted vertically, like a wheel, and supported on pivots at its axis between two standards rising from the supporting base of the lamp. The flaring mouth of the shell forms the hood of the shade, and within this, attached to the inner side of the shell under its roof as the shell is placed, is an incandescent electric light in its glass bulb. The shell, with the light shining through it, glows softly with an opalescent tint; by turning it on its pivots it can be set in any desired position to throw the light from under the hood upon the book, and with its attachment of flexible wire the lamp may be placed wherever it may be most convenient on the table.—Electricity.

Prof. Ewing, a noted English authority, in a recent lecture, remarked that it was said that a Chinese navigator named Hoang Ti as long ago as twenty-four centuries before Christ used a magnet for navigating a fleet of ships. This presumably was the first use of the mariner's compass. The form in which he is said to have used it was that of a fragment of lodestone, which was floated so as to be free to revolve. Lodestone, it will be remembered, is a natural magnet, consisting of the natural magnetic oxides of iron. The mariner's compass of Chinese origin was first brought to Europe in the thirteenth century by a man named Marco Polo. Notwithstanding these early uses of the magnet, the science of magnetism will be only three hundred years old next year, as it dates from the publication of Gilbert's famous book in the year 1600.—American Electrician.

What is said to be the first electric express line operated in Europe was recently started between Düsseldorf and Crefeld in Germany. The speeds obtained, which are from 33 to 36 miles per hour, are not very high according to American ideas, all the more so as the average is only about 24; but in Europe, especially with an electric line, this is considered quite a high speed. The distance is only 12 miles and a trip with one intermediate stop is made in half an hour, a car running every hour. Instead of the trolley wheel, the well-known contact bar, which is used so frequently in Europe, is used. A novelty consists in the use of two trolley wires, presumably to assure better contact and avoid arcing. There is only one motor on the car and that is a gearless one of 40 horse power, the idea being to avoid the disagreeable noises due to the gearing. These data are taken from a very brief description in L'Electricien.

Various alloys have been suggested for the material of brushes with the object of combining conductivity with as little friction as possible. The following alloys suggested by Boudreaux in the Elektrochemische Zeitscrift may be of interest. An alloy is made of copper with 0·20 per cent. of bismuth, 0·30 per cent. of cadmium, and 1·50 per cent. of antimony. These proportions may be varied, depending on the purpose for which the brush is to be used. The quantity of the ingredients should be doubled, for instance, if the commutator is of a hard bronze—like copper alloy, and to be tripled if of steel. Copper brushes are said to generate much more heat by friction than brushes made of these alloys. The metals may either be melted together, as usual, or they may be mixed as fine powders and then compressed together, with the aid of heat, into the desired form and consistency.—American Electrician.

Dr. Bemschke describes a simple method of measuring the speed of small fan motors. The motor to be tested, says Industries and Iron, London, is provided with a disk with holes. Another motor similarly provided is then obtained, and the two are placed nearly opposite each other, the second motor being arranged with a suitable resistance in series so that its speed may be adjusted. The two motors are then run, and the vanes of the fan are viewed through the holes in the disk. When the two speeds are equal, the vanes of the fan seen through these holes will appear to stand still so long as the number of vanes is equal to the number of holes. The speed of the second motor is adjusted until the vanes appear to stand still, and the speed is measured by a speed counter. Before the speeds are alike the vanes appear to move slowly in one direction or the other. Another application is the measuring of the frequency of an alternating current. A bottle of water is placed on a flexible stand attached to the armature of an electromagnet, through which the current passes, this being vibrated with a slight motion with vibrations equal in number to the frequency of the current. The water is then allowed to drop out of a hole in the bottom of the bottle, the number of drops being about equal to the number of oscillations. The stream of drops is looked at through the holes in the disk of the motor, and when the number of holes passing per second is equal to the number of drops, the latter will appear to be standing still. The speed of the motor is thus multiplied by the number of holes in the disk, the frequency of the current being thus obtained. When the speed is not exactly equal to the number of drops, they will appear to move upward and pass into the bottle.

MISCELLANEOUS NOTES.

The exports of coal, coke, cinders and fuel from the United Kingdom during January were 3,032,343 tons, as compared with 2,909,809 tons in January, 1898, and 2,763,954 tons in January, 1897.

In a recent issue The Nebraska Conservative states that the corn-producing States show much evidence of prosperity. It has come to stay, provided it is properly cared for. Condensation is necessary for its continuance. Just as the greatest success is achieved by industrial concentration, so will the best results be obtained by the people in corn-producing States in manufacturing grain into flour, cereal food, starch, glucose, and similar articles. The same net results can be had in these industries as already secured by the condensation of corn into beef and pork. The corn-growing States should not only have the producer's profit, but the manufacturer's. It is much wiser to retain this money than to send it out of the country. What the agricultural States need most is diversity of industry—factories, mills, and plants of all kinds employing labor, and, at the same time, teaching the young new occupations, are very desirable.

The pig iron production of the world in 1898 is estimated by the Hamburg firm of S. Elkan & Company in its annual circular at 34,906,000 tons, against a yearly average of 26,750,000 tons for the five years 1891–95. For 1898 the United States leads with 11,506,000 tons, followed by Great Britain with 8,850,000, Germany with 7,400,000, France with 2,250,000, and all other countries with 4,900,000. The average yearly production since 1871, in five-year periods and in 1,000,000 tons, has been as follows:

	1871–75.	1881–85.	1886–90.	1891–95.	1898.
United States........	2·3	4·3	7·2	8·2	11·5
Great Britain........	6·5	8·2	7·8	7·3	8·8
Germany....	1·9	3·4	4·2	5·1	7·4
France................	1·2	1·9	1·7	2·0	2·2
Other countries	2·1	3·8	3·3	4·0	4·9
Totals..........	14·1	20·7	24·2	26·7	34·9

Since 1871 the world's production has increased by 143 per cent.; that of Germany has increased fourfold, and that of the United States fivefold. England's has increased only 35 per cent.

In a paper on oil-producing seeds, in the Yearbook of the Department of Agriculture, Mr. Gilbert H. Hicks estimates, supposing that two pounds of seed are produced for every pound of ginned cotton, nearly 4,000,000 tons of cotton seed were produced in the United States in 1894–95. Deducting about one-third of this, required for sowing, there would remain more than 2,500,000 tons of seed. Of this amount, about 1,500,000 tons were worked at the oil mills, each ton producing 45 gallons of crude cotton seed oil and 800 pounds of cotton seed cake. This estimate gives a total of 60,000,000 gallons of oil and 600,000 tons of oil cake produced in the United States in a single year. At 30 cents a gallon, this crude oil was worth $18,000,000 while the oil cake exceeds $12,000,000 in value. Of this annual production of oil, about 9,000,000 gallons are used in making "compound lard," etc., while the rest is exported or is mixed with drying oils or used in the manufacture of soap. Cotton seed oil is also largely used for adulterating other oils.

The last year shows a decrease in the ratio of patents granted to patents applied for in Germany. The average ratio is now 30 per cent. But in some branches the percentage is much lower. Thus, of 1,199 applications for electric apparatus, only 265 were complied with; and of 937 ideas for improving the generation of gas, only 125 were approved of, i. e., were not thought old or otherwise unsuitable by the authorities. We append a few numbers for 1898, with those of 1897 in parentheses. Numbers of patents applied for, 20,321 (18,547); applications published, 6,504 (5,925); patents granted, 5,570 (5,440); annuled or withdrawn, 31 (22); expired or refused, 4,950 (4,573); remain in force, 19,932 (19,339). Sixty-two per cent. of the patentees were German subjects, 41 per cent. of them resided in Prussia, 38 per cent. abroad. As regards the registration of patterns, the authorities are less severe, 21,310 out of 23,199 applications being granted. The number of trade marks registered since 1894 is 35,103; 53,514 applications had been made. The Patent Office pays its expenses, and pays well indeed. The total income of the year 1898 amounted to 4,327,200 mark; this sum is made up of 402,000 mark for application fees, 3,116,000 mark for patent dues, 161,340 mark for registered patterns, 237,800 mark for trade marks, etc. The total expenses sum up to 1,821,625 mark. Thus there is a balance left of 2,505,500 mark, a nice sum of about £125,000.

The liqueur Chartreuse affords a curious instance of name evolution. Of course, everybody knows that it was originally a corruption of the Latin Carthusii, an order of monastics founded in the eleventh century, and taking its name from a little village near which the first monastery was founded, Carthusia, or in French Chartreuse. These monks were bound by their vows to eat no animal food, or rather no meat, or any preparations into which meat entered, and as they grew wealthy, they lusted after the flesh pots, the simple diet of bread and vegetables palled on their taste. Finally one of them invented a cake, the basis of which was a paste said to have been similar to or identical with the macaroni of to-day. The basis, however, cuts little figure in the mavelous cake into which it finally developed. The neighborhood of Carthusia, or Chartreuse, was noted then, as now, for the great variety of spicy herbs that grew there, and the peculiar richness developed by them. Gradually one after another of these herbs were introduced into the cake, along with wines of constantly increasing alcoholic strength, until finally brandy was used. In the meantime, various fruits were added to the body of the cake, until it finally became a mere crust of pastry, filled with fruits, spicy herbs, sugar, and brandy—a mince pie, in fact, without the meat. As the years and centuries rolled on, the process of evolution advanced. Having got to the point stated, one by one the solids began to disappear from the dish, being represented thereon merely by their essences, cunningly distilled, or otherwise obtained (by maceration, or by exhaustion in some form). Angelica and brandy increased in proportion, until finally the last solid was eliminated and Chartreuse, as we now know it, the most magnificent of all liqueurs, stood forth.—National Druggist.

SELECTED FORMULÆ.

Bed-bug Poisons.—The best of bug destroyers with which we have made personal experiment, says The National Druggist, is ordinary kerosene or coal oil. This instantly kills the developed insect and permeates and destroys the eggs. It has, moreover, the property of "creeping," or permeating narrow openings or crevices, thus following the creatures to their last resorts. It is cheap enough, but it has a disagreeable and offensive odor. Gasolin or benzene has the same properties, but is open to the same objection. The following is an excellent destroyer of the bugs and eggs:

Corrosive sublimate..........	1	part.
Camphor..	2	"
Oil of turpentine....................	4	"
Alcohol, sufficient to make...........	16	"

Mix.

This is efficient, has an odor of camphor and oil of turpentine, which is not offensive, but it is relatively not cheap.

Here is another:

Corrosive sublimate....	1	part.
Ammonium hydrochlorate	1	"
Glycerin..............	1	"
Water	16	"
Wood alcohol, sufficient to make...	32	"

Mix.

Label Paste.—We have published so many formulæ for label pastes within the past year that it is very difficult to make choice of the best. The Photographische Zeitung claims this formula as a "universal sticker, acting equally well with tin, glass, porcelain," etc.:

Gum arabic..........	42	parts.
Tragacanth in powder	32	"
Glycerin..............	180	"
Alcohol..................................	15	"
Thymol, sufficient, or say	1	"
Water, sufficient to make............	500	"

Dissolve the gum arabic in 60 parts of water; rub up tragacanth with 120 parts of water; mix the two liquids, pass the mixture through a fine sieve, and add the glycerin. Dissolve the thymol in the alcohol, and add to the mixture, and work thoroughly up together, adding the remainder of the water in the meantime. For a simpler paste the following will answer. It makes a pure white product of excellent adhesive power:

Tragacanth in powder.......	2	parts.
Boiling water..........	16	"
Wheat flour..	6	"
White dextrin	1	"
Cold water..............................	4	"

Mix the tragacanth and boiling water, stir, and set aside. Mix the flour, dextrin, and cold water, and add to the tragacanth. Have twenty-four parts of water in active ebullition, and into it pour the mixture. Add one part of glycerin and about one-half of one per cent. of salicylic acid, and let the whole boil from three to four minutes, then remove and let cool.

Whitewash for Brick Walls.—For brickwork, especially where exposed to damp, take half a peck of well burned quicklime, fresh from the kiln, slake with hot water sufficient to reduce it to a paste, and pass it through a fine sieve; add a gallon of clean white salt, which has been dissolved in a small quantity of boiling water, and a thin, smooth paste, also hot, made from 1 pound of fine rice flour; also ¼ of a pound of the best white glue, made in the water bath. Mix, stir well, and add ¼ of a pound of the best Spanish whiting in 5 quarts of boiling water; stir, cover to retain heat and exclude dust, and let it stand a week. Heat to boiling, stir, and apply hot. The above proportions will cover forty square yards.

Mucilage.—The Era Formulary gives these:

1. Rye flour..............................	4	ounces.
Powdered alum......................	½	"

Rub to a smooth paste with 8 ounces of cold water, strain through a cheese cloth, and pour into 1 pint of boiling water. Continue heat until thickened to suit. When nearly cold, add:

Glycerin.	1	ounce.
Oil of cloves..........................	30	drops.

This is suitable for tin or wood boxes or bottles, and keeps sweet for a long time.

2. Gum tragacanth	1	ounce.
Gum arabic............................	4	"
Dissolve in		
Water....................................	1	pint.
Strain, and add		
Thymol	14	grains.
Suspended in		
Glycerin..................................	4	ounces.
Add water to make	2	pints.

3.—POSTAGE STAMP MUCILAGE.

Dissolve 1 pint of gum dextrin in a pint of boiling water, strain through flannel and add 2 ounces of acetic acid. When nearly cold add 4 ounces of alcohol, stir constantly, and finally add enough warm water to make 1 quart.

STANDARD ADHESIVE MUCILAGE.

4. Gum arabic in fine powder..... ...	8	ounces.
Glucose	2	pounds.
Boiling water..........................	20	fl. ounces.
Acetic acid.............................	1	ounce.

Dissolve the gum arabic in the water, then add the glucose, and bring the whole to a good boil, stirring well. Remove from the fire, and, lastly, add the acetic acid.—Pharmaceutical Era.

Almondkleie.—

Almond meal	700	grammes.
Rice starch........................	160	"
Orris root............	70	"
Soap..............................	60	"
Oil of bitter almonds.....	1	"

Lotion for Baldness.—

Ammonium carbonate.........	2·5	grammes.
Orange flower water....	15·0	"
Glycerin..............	30·0	"
Tincture cantharides............	0·5	"
Oleo-balsamic mixture..........	50·0	"
Dilute alcohol (0·895)............	100·0	"

—Pharmaceutical Era.

"A THOUSAND DAYS IN THE ARCTIC."*

THE unvarnished tale of a thousand consecutive days in the Arctic, printed almost word for word as it was written, while the facts and impressions were fresh in the memory, is most interesting, and Mr. Jackson has produced a work which is of great scientific value. The remarkable revival of Arctic exploration which took place in 1818 has continued with more or less activity to the present time, and yet the Arctic regions seem to be now even more attractive than ever. Mr. Frederick G. Jackson, the narrator of this, the latest of Arctic voyages, sailed from the Thames in July, 1894, in command of an expedition which he successfully conducted for three years.

By the great generosity and public spirit of Mr. Alfred Harmsworth, Mr. Jackson, an enterprising young Englishman, was equipped and sent to make a thoroughly scientific exploration of Franz-Josef Land. Assisted by a small but carefully selected staff of scientific observers, Mr. Jackson set about his most arduous undertaking.

He determined the geographical limits of this land, which he found to consist of numerous islands of no very great extent in any direction; consequently, the idea of gaining a very high latitude was abandoned, and the efforts of the explorers were concentrated upon the thorough scientific examination of the group. This work was carried on under the most difficult conditions, owing to the rapid currents between the islands, which kept the ice almost constantly in motion, and to the sudden and extreme changes of temperature from intense frost to rapid thaw; these most trying changes being far in excess of those experienced in other parts of the Arctic regions. Mr. Jackson cannot be too highly praised for his endurance in the three years in this high latitude. He adhered to his purpose of carrying on scientific observations and collecting specimens in every department of natural science which these islands and the surrounding seas could illustrate. The long series of magnetical, meteorological, and other observations, together with the great and interesting collection of specimens made, amply repaid the outlay of the Jackson-Harmsworth expedition, which will long be remembered by the scientists of all nations for its rich contributions to their store of knowledge. But few explorers have ever had the opportunity of spending three consecutive years in the Arctic regions remote from human beings. This has been done when escape was not possible, yet Jackson and his companions cheerfully stayed on year after year, although they had an annual opportunity of returning by the "Windward."

In August, 1873, what was afterward called Franz-Josef Land was first accidentally discovered by the Austro-Hungarian expedition under the leadership of Weyprecht and Payer. In endeavoring to pass around the northern end of Novaya Zemlia to discover the Northeast Passage their ship, the "Tegethoff," became beset in the ice, and after drifting for twelve months an entirely new land came in sight, and the floe upon which the ship had been crushed up was frozen to the land-ice of Wilczek Island. The following spring Payer made three plucky and adventurous journeys up and in the neighborhood of what he then named Austria Sound. After a hard and perilous journey they were able to beat a retreat to Novaya Zemlia in their boats, leaving the ship to its fate on the shores of Franz-Josef Land, being quite of the opinion that the country was unapproachable by ordinary means. It was upon these observations that Arctic authorities advocated this route as the best for exploring to the northward, and upon this Mr. Jackson formulated his schemes in the year 1892, when he first published his plans which met with the approval of Arctic authorities. For some time, said Mr. Jackson, the sinews of war were conspicuous by their absence, and little encouragement was given, but finally Mr. Alfred Harmsworth, the well-known newspaper and magazine owner of London, generously offered to provide the necessary and long-sought funds for Mr. Jackson's proposed expedition. The "Windward" was bought and alterations effected in her. A log hut was made and erected at Archangel, and furs were purchased for the party. Owing to the great precautions in the selection and preparation of food, there was little illness of any of the party in the whole three years. The members of the party included Mr. Albert B. Armitage, who had charge of the astronomical, meteorological and magnetic observations. Dr. Reginald Koettlitz was the physician and geologist. Mr. Harry Fisher was the botanist and zoologist, and Mr. J. F. Child mineralogist. There were also four other members of the party.

On July 12, 1894, the party arrived on board the "Windward" at noon and set off almost immediately. Tromso was passed on July 24, and Archangel was reached on July 31. After some exciting adventures with the ice on September 10, Mr. Jackson established his winter quarters upon North Brook Island, and the work of discharging the cargo was begun.

From "A Thousand Days in the Arctic." Copyright, 1899, by Harper & Brothers.

AN ADDITION TO MR. JACKSON'S LARDER.

A walrus was shot, which was a start for the larder. The work of building the log house was arduous. The house was brought in pieces from Archangel. Each log was numbered in order that it could be put together with ease. The sledges containing the provisions were hauled to the top of the cliff with the aid of a steam winch. Several bears were shot at this time. Mr. Jackson showed a photograph of one of the bears just after he was killed. All the blood from the animals killed was kept and frozen, and every day a pound or so of the frozen blood was chipped out with an axe and added to the soup. Walrus meat does not appear to have been particularly palatable to the party; it was tough, coarse, dark in color, and had a distinct flavor of iodine.

That the Englishman will have his cold bath whether on the tableland of Tibet or in the Arctic regions is amply demonstrated by the narratives of Mr. Landor and Mr. Jackson. The latter arranged a bathroom in the only living room in the hut with canvas screens dropped down from the ceiling, which were rolled up when not in use. All the water used had to be melted from snow. This prevented them having more than one bath in the morning, but each man had one bath once a week. The actual living space in the hut was 13×12 feet, and in it the eight men lived, slept, and did their work. The members of the party went on board the vessel for their meals. The hut was heated by a slow combustion stove which measured 2 feet 2 inches by 1 foot 1 inch. This was found quite sufficient for heating the hut.

As days passed on, more and more improvements were made in the hut and observations were begun. Mr. Jackson's book contains a full record of the weather of each day. His description of the polar night is most interesting, as well as the accounts of the various hunting trips, in one of which a bear cub was captured which weighed 17 pounds and was 26 inches long. The bear cub was the source of great amusement; it cried exactly like an infant, and it was fed with condensed milk, which was forced down its throat. On February 10 the thermometer registered 37° below zero.

The first sledge journey of 1895 was begun in March. For a long time the party had been preparing for a preliminary journey northward, and as the end of the dark time approached, all became hurry and bustle. Sledges were built very much on the lines of those of Admiral McClintock, who is practically the father of sledging. The majority of them were 9½ feet long by 1½ feet wide, and the bodies of the sledges were raised 6 inches above the snow and ice. The runners were 3½ inches wide; the sledges weighed 16 pounds and were built in Norway. The parts were all lashed together with rawhide to give greater spring and elasticity to them. They were loaded with great care, Mr. Jackson attending personally to the matter; never more than 340 pounds being placed on any one sled.

Cape Flora was left on March 10 with two ponies drawing four sledges; the total weight was about 1,700 pounds, being the food and equipment of three men and two ponies for seven days. The party proceeded around the point of Cape Flora and up Miers Channel. The tent used on this journey was made in England, and opened and closed much like a Chinese lantern. The spirit stove was made of aluminum and weighed 5½ pounds, and on this all the provisions were cooked. Three pounds a day were allowed to each man. On reaching the spot where he decided to camp, Mr. Jackson's first care was for the animals. The ponies were taken out of the sledges and their blanket coats strapped on, and they were tied with halters and fed. The dogs were fastened as outposts to give warning of the approach of bears, and a pound of meat was given to each. They then proceeded to pitch their tent, getting into their furs, and then the dinner was cooked. Then followed a pipe of tobacco, and they all prepared to sleep for the night. This is not a very easy matter when the temperature is lower than 30° below zero and when a gale of wind is blowing. The inevitable cold bath of the Englishman is again in evidence. Mr. Jackson says: "I always stripped to the waist, and with a small piece of sponge and soap and a tooth-brush which I carry managed to freshen myself up considerably. Washing is a necessity. I never on one single morning missed it during the whole time that we were in Franz-Josef Land, with a solitary exception of three days in succession when we were blown off the coast in the summer of 1896 in an open boat in a gale of wind, and then we were very fully occupied in trying to keep afloat, and really had more washing than we desired. I have washed in temperatures as low as 46° below zero, stripping bare to the waist to do so, and never derived anything but good from it. But in my opinion the sense of cleanliness and freshness derived, if only comparative, owing to the lack of water, entirely compensates for the pains and penalties involved in the process. I may be 'faddy' on the subject, but I prefer a wash every morning, and had it."

And so on from day to day Mr. Jackson describes religiously the smallest happening of the trip, and it is this which gives the book its interest. It is a journal pure and simple, and as such is of course necessarily disjointed, but it is none the less valuable on this account. On the 16th of March they arrived at the hut.

From "A Thousand Days in the Arctic." Copyright, 1899, by Harper & Brothers.

THE INTERIOR OF MR. JACKSON'S HUT—TAKEN BY CANDLE LIGHT WITH FIVE HOURS' EXPOSURE.

Mr. Jackson made a second sledge journey in 1895, starting on April 16, and this resulted in the discovery of what was named Queen Victoria Sea. In the early part of June the ship was sawn out of the ice with a 12-foot saw, which was suspended on shear-legs and worked by seven men, and on July 3 the ship started for England, carrying mails and dispatches. After the "Windward" sailed preparations were made for explor-

* "A Thousand Days in the Arctic." By Frederick G. Jackson. New York and London: Harper & Brothers. 1899. Pp. 940. 8vo. Maps, illustrations. Price $6.

ing the coast in a whale boat. The trip was a most adventurous one, and resulted in their being nearly lost in a fierce storm which overwhelmed them while in an open boat. The various places which they visited were marked with cairns and flagstaffs, and the results obtained by their explorations were of solid scientific value, as they were an important contribution to the topography of this little-known region. The party returned on April 11. The preparations for the second winter were begun soon after this, and the various specimens which have been obtained during the summer were classified and preserved. Then follows Mr. Jackson's narrative of the winter, and considerable new land was discovered.

On June 17 occurred the most remarkable incident in the whole thousand days in the Arctic—an incident which is remarkable even when the many romantic incidents and thrilling events of Arctic exploration are considered; this was the meeting of Jackson and Nansen. Just after dinner Mr. Armitage came rushing in to tell Mr. Jackson that through his field glass he could see a man walking on the ice floe to the southeast of Cape Flora and about four miles out. At first it was thought that this was a walrus. Mr. Jackson got a gun and fired a shot to attract the stranger's attention, and started off to meet him coming across the ice. On nearer approach Jackson shouted to him and waved his cap. The English explorer thought that some accident had happened to the "Windward," and that this man had come off in a boat to communicate with the Cape Flora party. On approaching each other Jackson saw a tall man on "skis" in roughly made clothes and an old felt hat on his head; he was covered with oil and grease and black from head to feet; his hair was long and dirty; his complexion appeared to be fair, but dirt prevented anyone from being sure on this point. Jackson says, "We shook hands heartily, and I expressed the greatest pleasure in seeing him, and inquired if he had a ship. 'No,' he replied, 'my ship is not here;' and then he remarked he had only one companion, who was on the floe edge.

"It then struck me that his features, in spite of the black grease and long hair and beard, resembled Nansen, whom I had met once in London before he started, in 1893. Then I exclaimed:

"'Aren't you Nansen?'

"To which he replied: 'Yes, I am Nansen.' With much heartiness I shook him warmly by the hand and said: 'By Jove, I'm d—d glad to see you,' and congratulated him on his safe arrival." Nansen then gave a brief sketch of what had occurred. Nansen's first questions were in reference to his wife, and his second as to the politics of Norway. Nansen was cordially received at the hut and warmly cheered. He was given every luxury that the larder could supply, and afterward had a bath and a change of clean clothes, and when Johansen, Nansen's companion, arrived, he was looked after in the same manner.

In the spring of 1895 Jackson was within three or four miles of the spot where Nansen passed the winter of 1896, and the next spring Jackson was not far off from him. On both occasions Jackson had Nansen's letters in a little tin case, and it is curious to see how Nansen finally received his letters. This "post office" was undoubtedly in the highest latitude ever known. Nansen weighed 265 pounds when he arrived at the hut.

The days which Nansen passed at Cape Flora were most interesting, and the time was spent in going over collections, making and verifying maps, and so forth, and on July 26 the "Windward" hove in sight. The letters were received and distributed, and all had dinner on the "Windward." It seems that after leaving the summer before she was caught in the ice to the south and was locked in its unrelenting grasp to the beginning of December, and barely escaped passing another winter in the Arctic region. All the available timber of the ship was used as fuel for her engines to force her way clear of the ice pack. Jackson requested the captain of the "Windward" to write Mr. Harmsworth for permission to take the "Windward" to Christiania, and having received his permission offered to take Nansen there and then be guided entirely by the Norwegian explorer's wishes. The "Windward" sailed on August 7, and then comes the story of the third winter, which was taken up with preparation of the scientific collections, data, hunting, etc.

All the holidays were duly remembered, and it is almost pitiable to read of the Christmas dinner in the little cabin. Preparations were made at the first of the year for sledges, and as before important explorations were made, and Mr. Jackson's book is accompanied by a number of well executed maps which give the course of the various trips, and some hundreds of illustrations show the interesting nature of the finds and the difficulties of traveling. On July 22, 1897, the "Windward" was discovered, and the members of the party were naturally overjoyed to obtain letters and news from the outside world. Mr. Jackson wished to prolong his explorations in order that more of the coast and islands could be mapped, but other arrangements had been made in London in connection with the "Windward" which prevented her utilization for exploring purposes. The scientific collections were packed and carried on board; stores were put on board and a portion was left in case some explorers should be cast away on this inhospitable shore. August 6, 1897, the "Windward" steamed away from Cape Flora, and on September 3 the vessel was again in the Thames, carrying the party who for more than three years had been enduring the rigors of the Arctic climate. Hundreds of telegrams of congratulation poured in on Mr. Jackson from all over the world, and it is in exactly such painstaking and careful explorations as those conducted by Mr. Jackson that the value of exploration consists. The book is most elaborately illustrated and beautifully printed and we can recommend it to all lovers of Arctic literature.

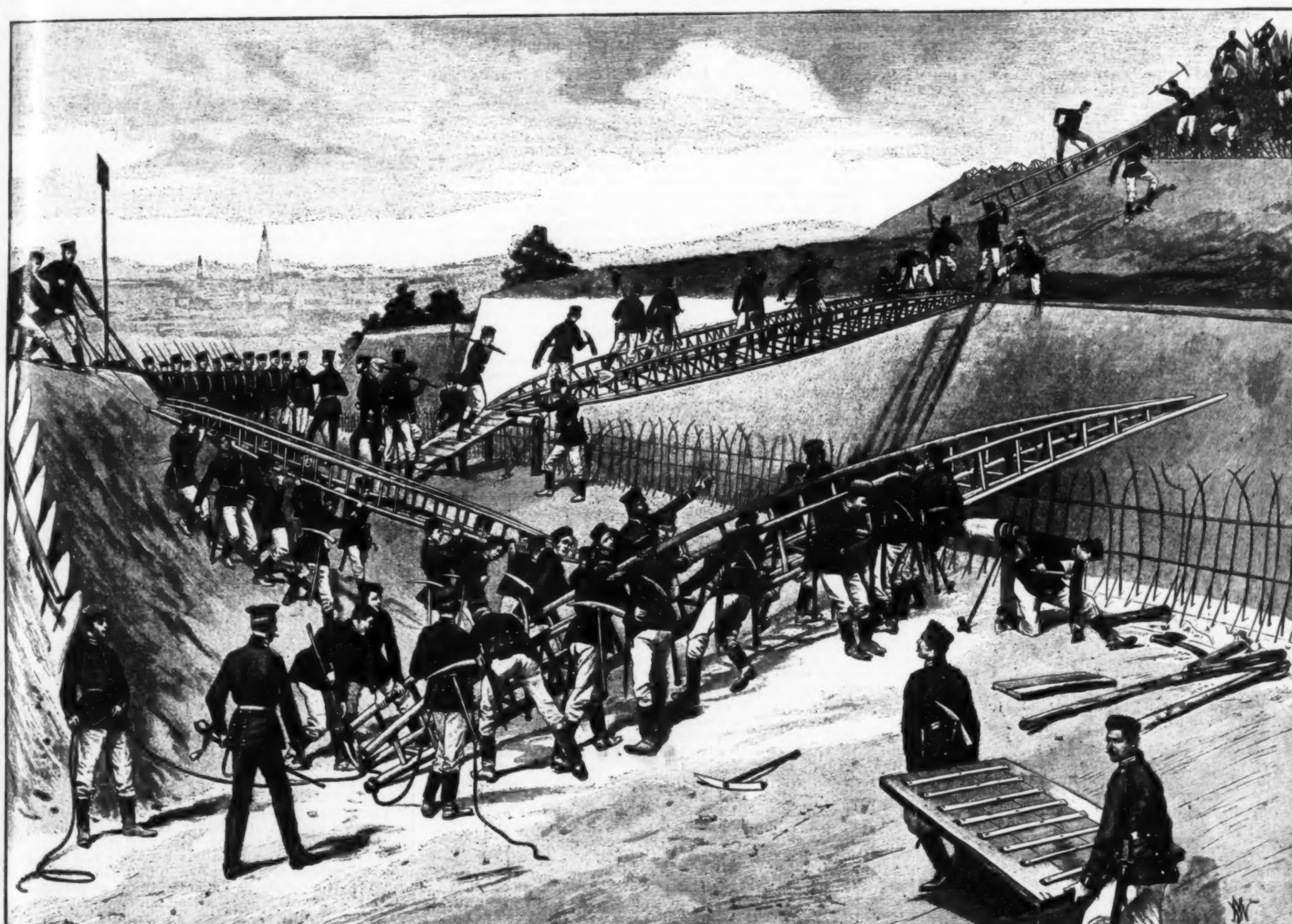
PRACTICE IN STORMING BREASTWORKS BY GERMAN ENGINEER CORPS.

Next in importance to building bridges over large or small streams, the chief work of the engineer corps of the German army consists in preparing the way for an attack upon a fortification. Frequent practice is given in this branch of service, and finally it is carried out on a large scale at the great drill in storming breastworks which is held every autumn. In this drill, each of the enemy's protected redoubts is finally taken by storm.

Real fortifications are often stormed by a sudden charge, instead of by a formal siege, after the artillery of the besiegers has made a breech in the breastworks. At every attack an infantry division of engineers precedes, carrying with it the proper tools to remove all obstacles in the way of the attacking columns or to bridge any gaps over which they will have to pass, thus clearing the road so far as possible for them. Deep ditches generally form the chief hindrances to the attack. These are either filled with water, or have barbed wire fences, caltrops, etc., placed wherever possible, so as to make them impassable. The engineers carry with them, therefore, especially constructed bridges for the purpose of bridging over the ditches for the attacking party. These bridges are from twenty-six to thirty-two feet in length, and require sixteen men to carry them, eight on each side. Two other men placed at the end of the bridge hold it back by ropes fastened when there is a steep escarpment to descend. Each bridge consists of a strong ladder with a low railing on each side. A wooden roller mounted on posts goes with each bridge, and is carried by two men.

This is set up on the edge of the ditch in the manner shown in our illustration, and serves as a support for the bridge at one end. The bridge is run over the roller till its end rests on the ground at the other side of the moat. The roller support at the near end also serves to raise the bridge sufficiently to clear the wire fence which is generally placed on the counterscarp as an obstruction.

As soon as the bridge has been thrown across, two men hastily run across and make the end fast, so it cannot slip off. The others then follow with hatchets, axes, etc., with which to destroy the palisades, fences, mines and the like. A floor of boards is usually laid for greater convenience of the infantry in the rear of the pioneer corps, and when there is time an incline leading up to the bridge is placed in position.—We are indebted to Das Buch für Allê for the above illustration and description.



PRACTICE IN STORMING BREASTWORKS, IN THE GERMAN ARMY.

One hundred buildings constructed of iron throughout have been shipped by a British firm to Mombasa, a seaport in British East Africa, to be used as a camp outfit for workmen employed in the building of the Uganda Railway. The cost of these buildings was about $750 each, so it is stated in press dispatches.

WHAT A WEATHER OBSERVER SHOULD KNOW.

By N. R. TAYLOR, Observer Weather Bureau.

WHAT must one know in order to become an observer in the United States Weather Bureau is a question that perhaps every man in this service has been called upon to answer times without number, and if this article will give an adequate reply to the query, the writer will feel that his labor has not been thrown away.

The Civil Service Commission will also answer the question from their standpoint and tell the would-be weather prophet that in addition to a fair knowledge of the three "R's" he must know something of physics, geography, history, etc., and a great deal of meteorology, in order to secure their diploma of eligibility, but they cannot tell, if their graduate is fortunate enough to receive his appointment, whether or not he will be a success.

A Weather Bureau man serving on station, whether he ranks as local forecast official, section director, observer, or revels in the three combined, to be a credit to the service, must be a man of education and training, and in addition to being, like Benjamin Franklin, a "philosopher, philanthropist and printer," should be a statistician, a geologist and a farmer; he must be able to prophesy of weather events to come and keep an accurate and comprehensive record of those past. He should be an electrician too; and an astronomer, unaided by any stargazing paraphernalia with which to sweep the heavens for lost comets.

That a weather observer should be a philosopher is almost too evident to discuss, as the science he represents is based on natural laws, many of which yet remain to be discovered, and the Weather Bureau of today with its remarkable achievements would not be in existence had not thinking men turned into account their knowledge of physics and applied it to the various atmospheric changes, until now the art of observing, forecasting, and tabulating weather conditions follows in importance close on the heels of the science from which it sprung.

It would not seem that philanthropy could enter into an occupation where cold-blooded calculations, facts and figures, play so important a part, but it should be remembered that an observer is at all times ready to brave every climate for the benefit of mankind and science; that his stations are scattered from the edge of the Arctic circle in Alaska to the tropical jungles of South America; that he should be equally competent to foretell a change of weather to the weary gold seeker on the Yukon, herald an approaching cold wave from his bleak post in the far Northwest, or recognize the incipient symptoms of a West India hurricane as it coils for a spring at our commerce in southern waters.

Although a printer is furnished to Weather Bureau stations whose publications are printed, yet there will often arise occasions when a knowledge of type setting would greatly increase the value of an observer and prevent many a temporary break in the records of his station.

Statistics play no small part in a weather observer's work, and in order to compile useful data from which to deduce important facts in the future, it is obvious that much depends upon records being intelligently as well as accurately kept. It is a popular belief among some that one day is the exact counterpart of some other; that back in some period of the world's history the atmosphere varied in pressure, the temperature rose and fell, the winds backed and veered and the clouds formed, changed their shape and melted away, each in their turn, with unvarying regularity, again and again, to be repeated in regular cycles as the unceasing mill of time grinds out the years. While many facts tend to prove the fallacy of this theory, climatic records do not yet extend far enough back to positively controvert it, and it rests with the weather observer in the future, with his accumulated data of centuries, to establish the truth.

The relation between climates and crops is so close that a knowledge of the latter is indispensable to the proper performance of an observer's duties, and he should also be geologist enough to study the soil in his State or Territory with a view to determine its special adaptability to the various products. The success of the pioneer, the enjoyment of the tourist, and the recovery of the health seeker depend not only upon the climate of a place but upon its productions as well. The up-to-date farmer is no longer a creature of mere brawn and muscle; he relies as much upon the science of his occupation for success as he does upon the sweat of his brow, and the official who represents the Climate and Crop Service of the Weather Bureau should be alive to all his needs and an unfailing source for any information he may require.

Many of the most important records of the Weather Bureau are now made by self-registering machines which do their work with the aid of electric contacts, and while it is not necessary to be an Edison or a Tesla in order to understand the few principles of electricity involved, an observer should, at least, be master enough of the science of this subtile fluid to account for and remedy any defects in the workings of his instruments.

While a knowledge of astronomy was mentioned as one of the requirements of a weather observer, it must not be supposed that this science is used in connection with meteorology in forecasting the weather, or that an observer should be able to chart the constellations of the heavens, figure out the time for the next transit of Venus, or measure the parallax of Sirius. There are times, however, when a knowledge of some of its elements is imperative, for he should know how to use those imaginary points and circles in the celestial sphere in order to intelligently describe any phenomena that might have a bearing upon his work. There is the aurora to be described in all its details, from the first arch of dawn-like light until it bursts forth in all its variegated splendor; there are halos of endless variety, both of sun and moon, to be noted; there are myriads of meteors that wander from their orbits among the stars and shoot into our atmosphere, leaving a fleeting but luminous track, which the quick eye of the observer should measure; and there are many other wonderful things constantly occurring among and above the clouds, a record of which would make useful data for future investigation.

There have been many marked improvements made in the Weather Bureau during its comparatively short existence; its methods are more scientific, its aims are broader, its results more satisfactory, and, in proportion to its progress, its need for intelligent observers is becoming more urgent. It is the dream of the chief of the Weather Bureau to some day strike the keynote to absolute accuracy in weather forecasting, and all his subordinates should indulge in the same hope and work for the same conclusion. To this end, no stone that could hide the precious secret should be left unturned, no experiment, however simple, be untried, and no theory be untested.—Monthly Weather Review.

THE COMMERCIAL DEVELOPMENT OF GERMANY.*

By C. ROZENRAAD, F.S.S.

AT a time when the commercial struggle of the nations is more acute than ever, when each country is trying to secure the largest possible share of the world's trade, it is of the highest importance that England should follow intently what her rivals and competitors are doing; for although Great Britain, with her extensive foreign and colonial trade and navigation, her well organized monetary and banking systems, is still marching at the head of the great commercial nations of the globe, other nations are not idle; indeed, some of them have made marvelous progress in every direction. This is especially the case with Germany, which, thanks to the zeal, energy, knowledge, and thoroughness of her business men, occupies an important place in the world's trade, forcing upon England a continual struggle everywhere. Indeed, it is not too much to say that Germany has become one of England's greatest commercial rivals.

It is not the first time that the Germans have taken a leading part in commerce. Already, in the middle ages, German commerce manifested its strength, not only in Germany itself, but also in foreign countries, where the big industrial cities of Germany had created commercial offices or Hanses, who had obtained, from the sovereign or government where they were constituted, numerous privileges. At first, these German Hanses were in direct and nearly exclusive relations with the towns which had created them, but little by little they joined into one confederacy, forming a defensive and offensive league for the maintenance of peace, the administration of justice, the extension of trade, the regulation of questions of customs, and the rate of exchange, representing, in a word, a powerful body.

This Hanseatic League owed its origin to the imperfection of the political and social institutions of Germany in the middle ages and to the insecurity of trade and navigation in northern Europe. As international relations gradually improved and Europe attained a higher degree of civilization, the utility of such a confederacy was less felt, and after four centuries of fluctuating prosperity, after having exercised a considerable influence on the commerce of Europe, they could no longer compete either with Holland, which had succeeded in attracting a large share of their business, or with England, which then had already secured a position of great importance, and had permanently become one of the principal commercial nations. The league was, therefore, dissolved in 1641. The history of the Hanses and that of the powerful Hansa towns, Hamburg, Bremen, Lübeck, and other cities, is one of the most interesting pages of the history of the commerce of the world, showing that, even in those days, the German merchants were already men of energy, of enterprising spirit, and endowed with great business capacity; but the same history shows also that already at that time there existed in Germany a party strongly in favor of protectionism; that, as in the present day, there were then numerous adherents to commercial restrictions, and absolutism in economical doctrines, the application of which paralyzed the development of international commerce, and often gave rise to rivalry between the various German states and towns. So that, suffering as they did from want of united action, none of the German states or commercial towns ever succeeded in recovering their former brilliant position, and it is only since 1871, when the battle of Sedan ended the dominating position of France in Europe and opened the way for the federation of the different German states into one empire, that Germany has come again to the front, in a marked manner.

Then the great German who was placed at the head of the affairs of his country showed clearly by his entire policy that the mainspring of his actions was not only to make Germany strong and powerful, but also to secure for her an important portion of the world's trade. After having provided a constitution for the united German empire, to the whole of which he applied the Zollverein, he enforced universal conscription, placed the railways in the hands of the government, introduced uniform weights, measures, and coins for the whole of Germany. In a word, Otto von Bismarck laid the foundation of the future great German empire, and, by his wise measures, enabled Germany to compete on the field of international commerce.

Realizing that gold is the precious metal, par excellence, in the settlement of all international transactions, that England with her gold standard and sound banking policy had become the principal gold and money market of the world, Bismarck created and accepted the presidency of the Imperial Bank of Germany, after having replaced the gulden, banco-mark, thaler, and louis d'or thaler by the reichsmark. He saw how England, by establishing numerous banks and branches in her colonies and in Africa, Asia, China, South and North America, had secured greater facilities for her trade; how bills on England and English acceptances were everywhere readily taken, so he induced his countrymen to establish German banking institutions in foreign parts, especially in countries beyond the sea, to make the German reichsmark and German bills of exchange familiar everywhere, and to secure to the German banks the commission, interest, and profit arising from exchange operations, hitherto paid to English banks, with the result that German banks are founded in the Argentine Republic, Brazil, Chile, and other countries.

It had likewise not escaped the great chancellor that a well organized consular corps can contribute materially to enlighten and to extend national trade, and under his able directions, and under those of his coadjutors, an elite class of men was formed, who, abroad, zealously promote the interests of Germany.

Bismarck saw that in England and France, the haute finance always supports the government in all that is necessary to advance the welfare and prosperity of the country; so he secured the counsel and advice of the leading bankers of Germany, especially that of the Berlin agent of the first banking house in the world. He observed how the great statesmen in England and France always valued the co-operation of capable men, and so he consulted the first German authority on monetary matters, Ludwig Bamberger, although the latter became his political opponent. He obtained the support of Delbruck, whose knowledge was invaluable in questions of treaties of commerce; of Stephan, who, in 1874, created the first postal union of the world, and gave Germany an almost perfect postal and telegraph service. Bismarck realized the value of the numerous steam lines which connect England with all parts of the world, so he encouraged the construction of German mail boats, obtained subsidies for German steamship companies to all parts of the globe, whose ships soon vied with English steamers in comfort, discipline, and speed. Last, but not least, he recognized that free trade was the foundation of England's wealth and prosperity, and the Iron Chancellor became a free trader, and succeeded in abolishing all import duties, with the exception of a few fiscal charges. And Europe looks full of admiration, the German people with feelings of gratitude, on the man whose indomitable will enabled him to carry out his schemes for the firm establishment of the greatness of Germany.

Just as under the strong government of Richelieu, Mazarin, and Colbert, France prospered; just as under Oliver Cromwell England had a period of great prosperity; just as under the sway of Napoleon III. the commerce and industry of France were in a flourishing state; so under Bismarck's régime Berlin became one of the principal financial centers of the world, showing again that business prospers in a country ruled by a strong political government. Under the iron hand which had unified and magnified Germany, German trade and industry developed in all directions.

But the Germans were carried away by their great prosperity. Intoxicated by their repeated success, led away by the French war contribution of five milliards of francs, they founded numerous companies and industrial undertakings lacking a solid basis; and, as is usually the case in times of great expansion of trade and industry, overproduction and overtrading provoked in Germany, first, a rapid decline in prices, and, finally, a severe crisis. This was but a repetition of what occurred in England in 1847, 1857, and 1866, when, owing to the disastrous results of overtrading, the government was compelled to suspend the Bank Act.

And Germany began to look for artificial remedies. Industry, always prone to protection, asserted itself; it demanded import duties, not so much as a measure of protection against foreign competition, because Germany already occupied an important position in industrial affairs, but in order to enforce higher prices; and when the German markets were flooded with American and Russian wheat, Bismarck had to yield to the representatives of industry and agriculture, who insisted upon protectionism, and the days of free trade in Germany were over. In 1879, the first protectionist tariff was adopted; the imports of foreign iron, wood, and grain were checked, and both Hamburg and Bremen, hitherto free ports, finally entered the German Zollverein. It soon became manifest, however, that, as is always the case, wherever protectionism is applied, one rise in the tariff is never sufficient; others are sure to follow. The industrial tariff was increased between 1881 and 1883, and the import duty on corn was raised successively in 1883 and 1887.

Now, the history of commerce teaches us that protectionism always fetters international trade, always leads to retaliation, and history repeated itself again in this case. The ever-increasing duty on grain had the effect of checking, if not of stopping altogether, the export to Germany of the principal article of Russian production—wheat. And so Russia retaliated by imposing a heavy import duty upon Germany's principal articles of production—iron and steel.

And gradually the relations between the two great powers became less friendly. The tariff war was followed by the expulsion by the German government of the Poles who worked in the factories and harbors near the frontiers. Russia retaliated by imposing regulations tending to restrict the rights of foreigners to hold property in Russia. In a word, the struggle between the two great northern powers became fiercer and fiercer, till the German government attempted a great coup to undermine the credit of the enemy, and, by decree of November 10, 1887, the Imperial Bank of Germany declined to make any further advances on Russian securities. From a moral and from a political standpoint, the significance of the decree was of the highest importance. For it must not be forgotten that Prince Bismarck was not only Imperial Chancellor, but also President of the Imperial Bank of Germany, and the refusal to advance money on the securities of a country with which Germany still continued to be, officially, on friendly terms, could certainly not have been adopted without his knowledge, or without his entire consent.

Small causes sometimes have great results. The introduction of protectionism in Germany gave rise to the tariff war, afterward to the financial war with Russia, which, in its turn, led to the political and financial alliance between Russia and France—an alliance which, to a great extent, helped Russia to place her finances and her monetary system on a sounder basis, and enabled her to become a dominating power, not only on the Continent, but also in Central Asia, and to follow in the Far East the policy with which we are all acquainted.

As you see, protectionism has been the main cause of important international events, the consequences of which cannot be foreseen even at this juncture: while in Germany itself the further development of protectionism went hand in hand with the progress of socialism. In vain did the government propose measures for promoting the welfare of the working man and the improvement of his lot. Gradually, the

* A paper read before the Society of Arts, London, March 21, 1899.

situation became more and more critical, and although Bismarck succeeded in maintaining his prestige as regards foreign politics, his domestic policy did not meet with the same appreciation as formerly, either from crown or from nation. His fall became merely a question of days, of hours, till at last the faithful servant of monarch and fatherland had to disappear from the political arena. He may have committed many errors, but to him belongs the honor of having laid the foundation of the present mighty German empire as a political and commercial nation.

The work of the greatest statesman of our century was continued by his successor, Caprivi, but under much more moderate commercial and fiscal conditions. The political alliance with Austria and Italy concluded by Bismarck made it possible for his successor to complete it by a commercial alliance with both countries. On the 6th of December, 1891, a commercial treaty, based upon lower tariffs, was concluded between Germany and Austria. It was followed on February 1, 1892, by similar treaties with Italy, Switzerland, Belgium and Servia, while a treaty of commerce and navigation was entered into with Roumania on the 1st January, 1894. These treaties may not be the ideal of what commercial treaties should be, but nevertheless they prove that an end has been put to the sharp protectionist policy followed hitherto by Germany, that more moderate ideas have gained the upper hand there. These treaties being concluded for a term of twelve years will safeguard trade against further tariff variations, at least for that period.

But it was not only with allies and friendly nations that Caprivi concluded commercial treaties. He did so even with Germany's antagonist, Russia. On the 8th March, 1894, he entered into a commercial treaty with the government of the Czar, thereby putting an end to the tariff war with Russia, canceling also the decree of the Imperial Bank of Germany of the 10th November, 1887, which prohibited advances on Russian securities. So that a more moderate commercial policy healed the wounds inflicted by extreme protectionism, the amicable relations between the two great northern empires were restored, and Berlin once again participated, in a marked manner, in the important Russian financial operations connected with the abolition of the forced currency in that country.

And the favorable results which have followed the more moderate commercial policy inaugurated by Germany became more evident. Her influence and commerce developed in all directions. In industry, she became a power; in chemical and electric industries, the Germans are gradually taking the lead. German banks abroad (the Brazilian Bank for Germany, with a capital of 10,000,000 marks, is represented in Rio de Janeiro, Sao Paolo, Santos, etc.; the Deutsche Ubersee Bank, with a capital of 20,000,000 marks, has offices in Buenos Ayres, Valparaiso, etc.; the Bank of Chile and Germany, with a capital of 10,000,000 marks, is also established in Valparaiso; while the German Asiatic Bank, with a capital of 15,000,000 marks, is represented in Shanghai, Tientsin and Calcutta) contribute, with success, to the promotion of German trade abroad, earning satisfactory dividends for their share-holders.

In Italy, immediately after the disastrous crisis in 1893, which caused 44 banks and banking houses to suspend payment, the German haute banque, together with their friends in Austria and Switzerland, founded two banking institutions—in Milan, the Banca Commerciale; in Genoa, the Credito Italiano, both of which render important services to Italian trade and industry.

Germany, however, is not only represented abroad by banks, but also by her surplus population, which is increasing by nearly 1 per cent. every year. The total population now exceeds 54,000,000, as against 42,500,000 in 1874. Germany sends her sons, fully equipped with the knowledge of foreign languages, to all parts of the world, some as clerks and commercial travelers, others as technical officials and engineers, endeavoring to create new markets and to develop trade between the fatherland and foreign countries. Everywhere we find Germans and German houses, while German capital is invested in many foreign enterprises. The Keneh Assian Railway was built entirely with German capital, while Germany is largely interested in the Netherland South African Railway Company, in the Brazilian Railway Oeste de Minas, and others. Germany is besides busily engaged in Turkey, covering that country with a network of railways. In Russia, Germany has found a large field for her energies, especially in connection with the building of the Siberian Railway, which, when completed, will shorten the voyage for both passengers and goods from Western Europe to China and Japan, and, as the new route traverses Germany from one end to the other, the German railways will reap increased receipts from passengers and goods, without even counting the very important mail traffic between England and the Far East, which now goes via the Suez Canal, and which, by the new route, via Germany, will also yield considerable advantages to that empire.

According to official figures, nearly 140,000,000 marks of German capital are engaged in Guatemala, of which half is in plantations; in Mexico, nearly 400,000,000; in Venezuela, nearly 200,000,000; in Brazil, nearly 650,000,000, of which the greater part has been invested in industrial and land enterprises; in Chile, the German capital employed is estimated at 28,000,000, chiefly invested in saltpeter mines; in Africa, 100,000,000 marks. These investments represent more than 1,500,000,000 of marks, while the total amount of German capital employed in foreign stocks is estimated at many millions more.

But the great development of trade and industry, the great progress in every domain, and especially the importance the Berlin Bourse has attained as an international market, were a thorn in the side of the Agrarian party, which succeeded in getting a law passed by which Stock Exchange transactions and time-bargains were hampered, in many cases rendered impossible, and by this the German grain market was disorganized.

Whereas commerce in England is regarded as the greatest of all political interests, in Germany the reactionary party attempted to impede as much as possible the further extension of speculative transactions, of commerce, and of industry.

But the German Agrarians have been foiled, for Bourse, commerce and industry combined energetically to oppose such a short-sighted policy, and the very obstacles they experienced spurred them on to greater activity. The aim of Germany to acquire a large portion of the world's trade remained the same.

The statistics of recent years prove how active German trade and industry have been. From 1872 to 1897 the trade increased 60 per cent., and 30 per cent. between 1881 and 1897. The larger part of this increase is due to the shipping trade, being about 65 per cent. of the total.

In 1898 the commercial advance, far from being reduced, has increased in large proportions. This development will be seen from the following figures:

IMPORTS.

Year.		In tons.		In 1,000 marks.
1894	....	32,022,502	....	4,285,333
1895	....	32,536,976	....	4,246,111
1896	....	36,410,257	....	4,557,951
1897	....	40,162,317	....	4,864,644
1898	....	42,718,075	....	5,477,648

EXPORTS.

1894	....	22,833,715	....	3,051,480
1895	....	23,829,658	....	3,424,076
1896	....	25,719,876	....	3,753,822
1897	....	28,019,949	....	3,786,241
1898	....	30,086,228	....	4,001,746

Or less imports and exports of gold and silver:—

		IMPORTS. In 1,000 marks.		EXPORTS. In 1,000 marks.
1896	....	4,307,163	....	3,525,130
1897	....	4,680,697	....	3,634,975
1898	....	5,118,529	....	3,746,628

Compared with other countries, Germany has, indeed, made great progress, as will be seen by the figures in Table I.

TABLE I.—INCREASE IN GERMAN TRADE COMPARED WITH THAT OF GREAT BRITAIN, THE UNITED STATES, FRANCE, ITALY, AND AUSTRIA-HUNGARY, 1897–98.

IMPORTS.

Country.	1897		1898.		Increase + or Decrease −
Great Britain		£451,029,000		£470,518,000	+ £19,480,000
Germany	M. 4,864,644,000	£243,232,200	M. 5,477,648,000	£273,882,400	+ £30,650,200
United States	$ 742,595,000	£148,519,000	$ 633,665,000	£126,733,000	− £21,786,000
France	Frs. 3,956,027,000	£158,241,080	Frs. 4,376,195,000	£175,047,800	+ £16,806,720
Italy	Frs. 1,191,598,770	£ 44,133,287	Frs. 1,413,335,346	£ 52,345,753	+ £ 8,212,465
Austria-Hungary	Fl. 755,300,000	£ 62,941,666	Fl. 830,900,000	£ 69,241,666	+ £ 6,300,000

EXPORTS.

Country.	1897.		1898.		Increase + or Decrease −
Great Britain		£234,220,000		£233,391,000	− £ 829,000
Germany	M. 3,786,241,000	£189,312,050	M. 4,001,746,000	£200,087,300	+ £10,775,250
United States	$ 1,099,709,000	£219,941,800	$ 1,254,925,000	£250,985,000	+ £31,043,200
France	Frs. 3,597,952,000	£143,918,080	Frs. 3,503,167,000	£140,126,680	− £ 3,791,400
Italy	Frs. 1,091,734,230	£ 40,434,601	Frs. 1,203,560,304	£ 44,576,640	+ £ 4,142,039
Austria-Hungary	Fl. 766,200,000	£ 63,850,000	Fl. 808,800,000	£ 67,400,000	+ £ 3,550,000

This development is all the more remarkable, as Germany had, like many other nations, to struggle against the protectionist system applied by several countries. It is partly due to the many export unions (Ausführvereine), whose principal object is to promote foreign trade. Especially the Export Union of Saxony is to be mentioned. Established in May, 1885, with only 200 members, paying an annual subscription of 20 marks each, that union has now thousands of members sending out traveling commissions, circulars in five languages, spending between 1886 and 1895 38,000 marks to investigate trade prospects in Venezuela, Ecuador, Peru, Bolivia, Chile, Mexico, Canada, Cuba, etc. In Berlin many corporations and newspapers are working in the same direction, for instance, to quote only a few: The Centralverein, for commercial geography and promotion of foreign trade; the Deutsche Colonialverein, with 250 agents in London, Antwerp, and other important commercial markets. In a word, by constant efforts, by continued study and investigation, Germany endeavors to extend her trade in every respect. The commercial struggle between the nations is now so acute that the efforts of one single firm are not sufficient; they all work together, publishing illustrated almanacs, giving every detail of home products, the addresses of the firms who export them, and readily complying with the requirements of the foreign customers, whether in quality or mode of packing the goods, selling not in marks, but in the currency of the customer, trying in every way to please the client and to facilitate the buying of German goods.

But all these efforts would probably not have had the great results shown by the constant increase in Germany's exports mentioned before, had German commerce not found in Hamburg a most suitable place for the concentration of the export trade. The old Hanse town, with her international trade established centuries ago, with her branches and agents in every country, with her extensive shipping business, is really the principal commercial German town, the principal German market, and no efforts are spared by the Hamburg merchants to maintain that position. Since joining the Zollverein, Hamburg has not only spent more than 300,000,000 marks on improvements in the harbor, but the steam lines connecting that port with all parts of the globe are constantly increasing, with the result that Hamburg is now the first port on the Continent, ranking immediately after London. The shipping trade of that port for 1898, compared with the three former years, is as follows:

	Entered.		Cleared.	
	Ships.	Tonnage.	Ships.	Tonnage.
1898	12,523	7,355,000	12,532	7,393,000
1897	11,173	6,708,000	11,299	6,852,000
1896	10,477	6,445,000	10,371	6,300,000
1895	9,443	6,254,000	9,446	6,280,000

We must not forget Bremen, whose new harbor accommodation, costing 100,000,000 of marks, has contributed immensely to the development of her shipping trade. Besides, by the practical organization of her cotton exchange, Bremen is now the first cotton market on the Continent, the second in Europe. The American crop last season was 11,500,000 bales, of which not less than 1,709,000 were sent to Bremen.

(To be continued.)

STORE WINDOW WASHING.

WHAT the eye is to the face the window is to the store, and if the face or the store is to be attractive, the eye or the window must be bright. To secure this effect the plate glass, costing its scores or even hundreds of dollars, has entirely superseded the old window glass, costing as many cents. One is no more transparent than the other, but one possesses a cleanliness and a luster which was formerly lacking, and that is worth the added cost.

Still the problem is not yet wholly solved, and the weekly window cleaning is usually a matter which is dreaded. So simple an operation is it that it is intrusted to the greenest tyro, yet so difficult of perfection that the most expert would hesitate to claim its attainment.

F. Foerster, a German chemist, has done a large amount of careful experimenting during the past five years to ascertain the exact vulnerability of different kinds of glass under different conditions. His conclusions, which are very interesting, have been made upon plate and window glass, as well as glass for chemical ware.

In a series of experiments upon six different kinds of plate glass, Foerster found that at 20° C. pure water dissolved 1·65 grain to 1·11 grain of glass per 15·5 square inches (100 square cm.), while a 1 per cent. solution of sulphuric acid dissolved 1·325 to 1·54 grain, 1 per cent. nitric acid dissolved 1·90 to 1·35 grain, 1 per cent. hydrochloric acid dissolved 1·325 to 1·40 grain, and 1 per cent. acetic acid 1·325 to 1·58 grain each per 15·5 square inches of glass.

In a series of elaborate tables he has demonstrated the action of different strength solutions of acids and of water upon glasses of different compositions, and under different conditions of time, temperature, etc., but the above facts are sufficient for our purpose.

Now for the application of the facts. In window washing the first consideration is to remove the dirt, and the second to polish the glass. From a scientific point of view, these two are antagonistic. One aims to remove matter, the other to prevent the removal of matter. But, since the matter in consideration is not the same in each case, the problem is easily solved by keeping the proper sequence.

For the removal of dirt a weak alkali is the most generally efficient. It is to the liberation of alkali, by the decomposition of soap when dissolved in water, that the detergent properties of soap are, in part, due.

Glass is undoubtedly more easily cleaned by the occasional use of weak alkali than by pure water, though the latter is both sufficient and efficient if used frequently enough. Since ammonia has less action on glass than soda or potash, it is to be preferred, and, further, the water should not be hot. But, at best, the alkali will attack the glass, suspend some of the silica, and cause the dreaded streakedness.

Then, to correct this, after the removal of the dirt, an application of weak acid is desirable. Either hydrochloric or acetic acid is to be preferred here, on account of their volatility and absence of corrosive properties, and hydrochloric acid has the advantage in point of cost.

Then the sequence is, first an alkali to remove the dirt, and then an acid to polish the glass. If to these we add another factor, a polishing agent in the shape of some substance which will produce a mild friction without scratching, we have combined all the virtues of the commercial preparations for this purpose without their defects and with an added virtue.

I would recommend the following procedure: 1. Wash the glass in the usual manner with water containing about ½ ounce of concentrated ammonia water to a pailful of water—not more, for fear of removing the paint or varnish from the woodwork.

Then, while the glass is wet, and without rinsing, go over the entire surface with a weak solution of hydrochloric acid, prepared by adding to a pailful of fresh water 2 or 3 ounces of strong muriatic acid. This neutralizes the ammonia and the alkali in the glass, and forms some soluble chlorides which aid in the polishing. Finally, dry and polish with a clean cloth.

The acid will have no ill effects upon paint or varnish upon the window frames, nor even upon unpainted woodwork.

If metal window frames hold the glass, the acid is

liable to attack these, and should be avoided or used cautiously. A weaker acid would be advisable in this case.

Some have tried this plan and are pleased with the result. They think that the time taken to go over the glass with two successive waters is more than compensated in the saving of time in the drying and polishing, and then the window is brighter.

But if you wash windows so frequently that they do not get really dirty, the alkaline water might be omitted, and you may be pleased with the result if the hydrochloric solution is used in place of pure water. The addition of a little salt to this might prove a further pleasure.—W. L. Scoville in The American Druggist.

[Continued from SUPPLEMENT, No. 1222, page 19588.]

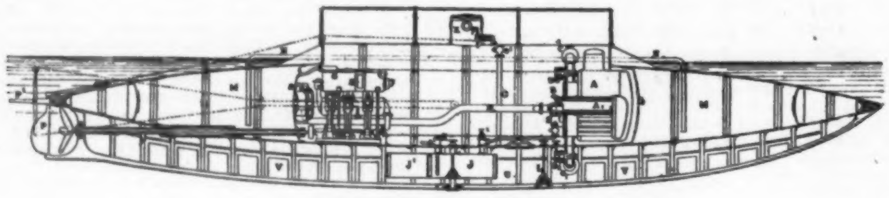
THE PROGRESS OF SUBMARINE NAVIGATION.

THE second period was one of indecision. An endeavor was making to apply to submarine boats the various industrial improvements in measure as they appeared. This period, sterile in results, was prolific in ideas; and patents multiplied therein. Many inventors did not even originate a complete submarine boat, but simply devised some new motor, or proposed a new fuel or a new method of submersion.

The descriptions which accompany the figures are of an astonishing variety in their monotony. There is no longer any question as to the use of powder motors, yet we find some of these, and also carbonic acid, gas, ammonia, ether, gasoline, steam and electric ones. As for submersion, that is effected in four ways: through the introduction of water, through a horizontal rudder, through a vertical screw, and through a diminution of volume, that is to say, through displacement.

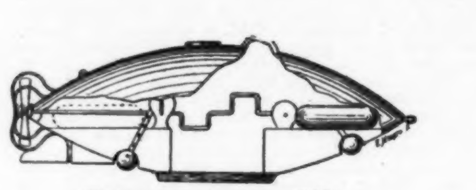
It was soon perceived that none of these methods contained in itself a complete solution of the question. Then the methods were amalgamated. With Admiral Bourgeois and Brun in France, and Alstitt in America, appeared the mixed methods.

The Alstitt submarine boat navigated by steam while afloat and by electricity when submerged. This



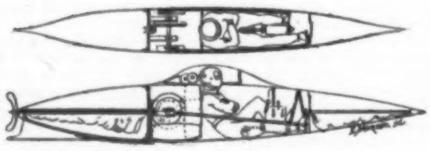
D'ALLEST. French (1886).

Length, 62·25 feet; diameter, 6·5 feet; propulsion by a steam motor with gasoline as fuel; submersion through the introduction of water and the use of a rudder. *A*, boiler; *A'*, furnace; *B*, burner; *D*, bulkhead; *D'*, cock of the chimney; *E*, steam engine; *G*, air compressor; *H*, ventilator; *L*, submersion cock; *M*, reservoir of compressed air; *P*, rudder; *P'*, submersion rudder.



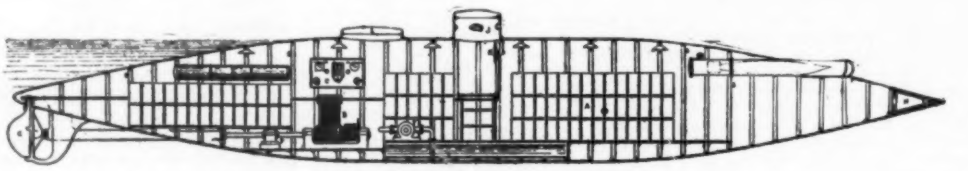
HALSTEAD. American (1872).

The "Intelligent Whale." Length, 29·5 feet; diameter, 8·75 feet; propulsion by a screw actuated by two winches; submersion through the introduction of water.



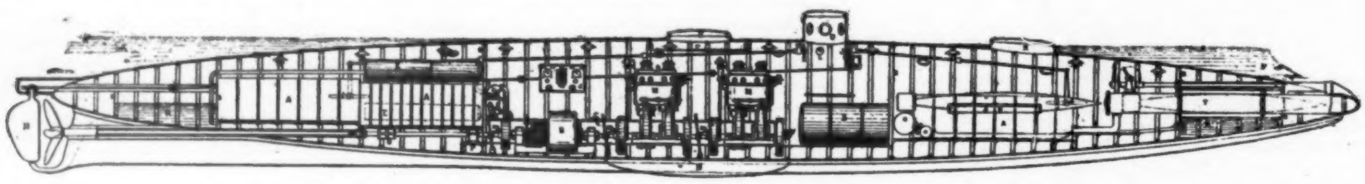
HOLLAND No. 1. American (1875).

Length, 16·5 feet; width, 1·75 feet; height, 2 feet; propulsion by a pedal and screw; submersion through the introduction of water.



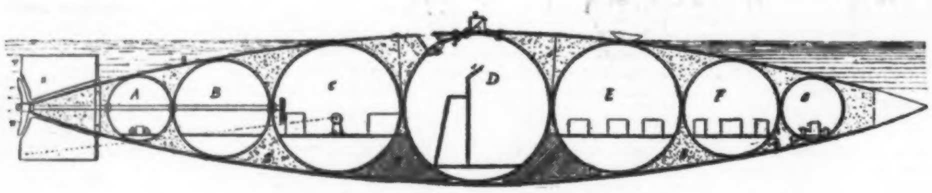
PERAL. Spanish (1889).

Length, 72 feet; diameter, 9·5 feet; burden, 87 tons; propulsion by an electric motor; submersion through the introduction of water.



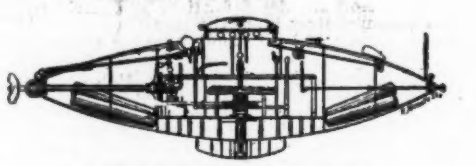
FOREST. French (1891).

Length, 108 feet; diameter, 9 feet; tonnage, 135 tons; propulsion by a gasoline motor while afloat and by electricity while submerged; submersion through the introduction of water and by horizontal rudders; provided with torpedo tubes.



PIATTI DEL POZZO. Italian (1894).

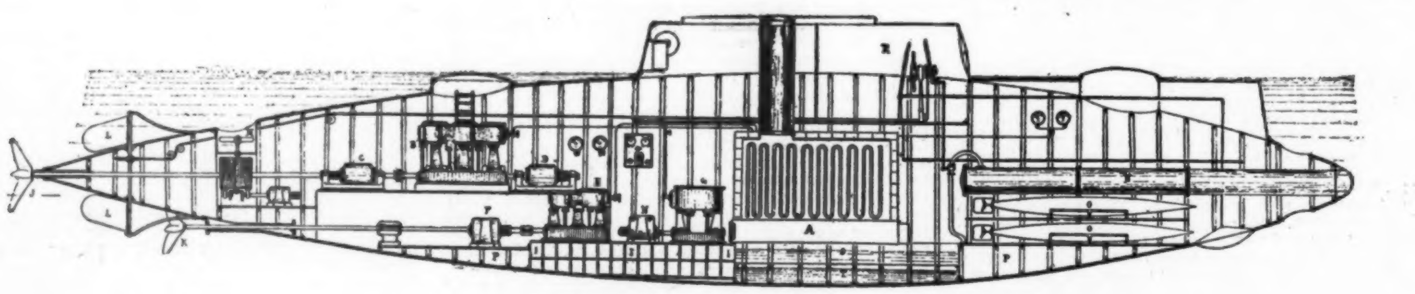
Length, 74 feet; seven spherical compartments, *A*, *B*, *C*, *D*, *E*, *F*, *G*; the central compartment, 11·5 feet in diameter, detaches itself in case of danger and rises to the surface; propulsion by a screw actuated by a motor of unknown character; submersion through the introduction of water.



GOUBET No. 1. French (1889).

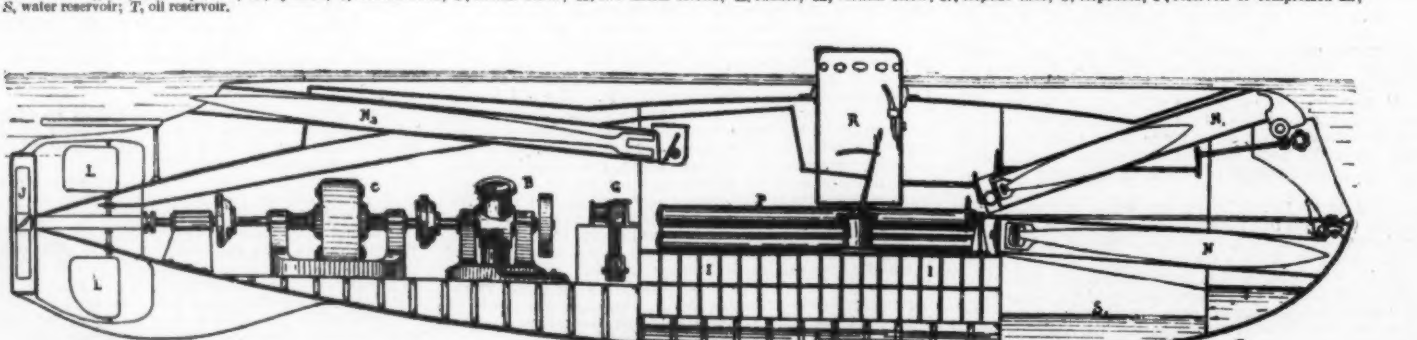
Length, 16·5 feet; width, 3·28 feet; height, 6 feet; propulsion by a jointed screw and an electric motor.

The principal data regarding Goubet No. 2 (1896) are: Length, 26·25 feet; diameter, 6 feet; propulsion by a jointed screw and an electric motor of 4 H. P. and by oars; armed with torpedo wire cutter and two torpedoes placed at the sides; hull of bronze.



HOLLAND No. 2. American (1892).

The "Plunger." Length, 80 feet; diameter, 11 feet; tonnage, 146 tons; speed, 14 knots afloat and 8 when submerged; propulsion by a steam motor while afloat and by electricity while submerged; submersion through a reservoir of water and vertical screw; armorclad; provided with torpedo tubes. *A*, boiler; *B*, central engine; *C*, dynamos; *D*, dynamos; *E*, two engines at the sides; *F*, two dynamos coupled with these engines; *G*, compressor; *H*, dynamo; *I*, accumulators; *J*, central screw; *K*, two lateral screws; *L*, rudder; *M*, vertical screw; *N*, torpedo tube; *O*, torpedoes; *P*, reservoir of compressed air; *S*, water reservoir; *T*, oil reservoir.



HOLLAND No. 3. American (1896).

Length, 55 feet; diameter, 10 feet; propulsion by a gas motor while afloat and electricity while submerged; submersion through the introduction of water; armed with torpedoes. *B*, gas engine; *C*, dynamo; *G*, air compressor; *I*, accumulators; *J*, screw; *L*, rudder; *N*, Whitehead torpedo tube; *N'*, aerial torpedo tube; *N''*, dynamite torpedo tube; *P*, reservoirs of compressed air; *R*, conning tower; *S*, water reservoir; *S'*, reservoir of water for ballast; *T*, oil reservoir.

THE PROGRESS OF SUBMARINE NAVIGATION.

is the principle to which a return has been made at the present day, after the exclusive use of electricity had been recommended.

As for Bourgeois and Brun's "Plongeur," launched in 1863, that was truly a *chef d'œuvre* for the epoch. It was 146 feet in length and was propelled by a six-bladed screw driven by an 80 horse power compressed air-engine. It was a genuine ship, capable of carrying a large crew. The submersion was effected through the introduction of water, but the depth of submersion was regulated both by hydrostatic pistons and a vertical screw turned by hand.

This submarine boat was tried for a long time in the Rochefort basin, and then in the roadstead of Palisse. Although the learned admiral had long studied the multiple conditions of submarine navigation—longitudinal and latitudinal stability of position, stability en route and stability upon submersion—it was in stability that the "Plongeur" was lacking. It was dismantled in 1864, but the results of the trials of it were, it seems, not without value in the studies of the "Gustave Zédé" and "Morse."

The "Gustave Zédé," "Morse" and "Narval" types, all three built in France under the direction of the engineers of naval construction, form provisionally at least the last step in submarine navigation.

The "Gustave Zédé" No. 2, the recent trials of which have made so much stir, is a submarine torpedo boat entirely electric. Its cylindro-conical hull of Roma metal is 148 feet in length and 11 feet in diameter. It displaces 260 tons. Propulsion is given by a screw actuated by an electric motor of 750 horse power constructed by Messrs. Sautter & Harlé, and supplied by a battery of Laurent City accumulators. An air compressor is used for charging the reservoirs for the service on board and the launching of the torpedoes. This boat dates back to 1892.

Forty-seven inventors took part in the competition of 1897. Six projects only were complete—those of Messrs. Romazzotti, Mangas, Labeuf, Drzewiecki, Forest and Philippeau. Gold medals were awarded to the authors of projects who belonged to the navy. A new submarine boat by M. Drzewiecki, a Russian engineer, whose 1881 model has already been reproduced several times in Russia, was classed with No. 2 and obtained a prize of 5,000 francs. A prize of 3,000 francs was awarded to Mr. Forest, and one of 500 to M. Philippeau. Finally, the following propositions were formulated by the council board: that the construction of Romazzotti's "Morse" should be actively pushed forward at Cherbourg; that Mr. Labeuf's project for a submergible boat should be placed under study; and that M. Drzewiecki's apparatus for launching torpedoes and M. Forest's petroleum motor should be tried upon a torpedo boat.

These recommendations are now partially realized. The "Morse" has been submitted to tests as to tightness of its Roma metal hull, and M. Labeuf's "Narval" is under construction. The "Morse" is a small and greatly improved "Gustave Zédé." As for the "Narval," that, properly speaking, will not be a submarine boat, but rather a submergible one. Navigating on the surface of the water and its dome emerging from the sea, it will, under such circumstances, escape the quasi-blindness of its brethren. M. Laganne proposed such a solution as long ago as 1881. His project, eighteen years old, thus becomes a reality. As may be seen from the figure that we publish, it included, above the hull, a float 5 feet in thickness formed of pieces of juxtaposed wood, which rendered the boat incapable of capsizing.

The very selection of the "Narval" type by the French navy shows what data of the problem of submarine navigation still remain without satisfactory solution. The submarine boats of to-day are submerged with ease and move forward with sufficient rapidity; their stability is satisfactory, their evolutions are easy, the air is respirable in them, and the progress of chemistry is upon the eve of assuring the continuous and almost indefinite renewal of it. It only remains to discover optical and steering apparatus that shall permit of traveling under water.

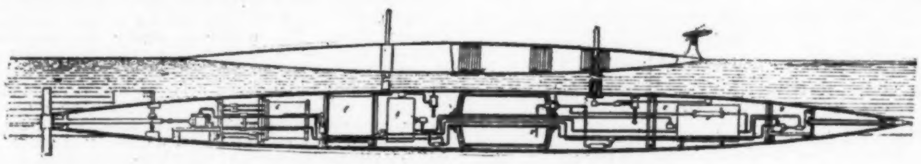
From what precedes, it may easily be seen how greatly the problem of submarine navigation has haunted the imagination of inventors. As we have already stated, our nomenclature embraces all the projects of which a practical application has been made.

In addition to these, how many there are that have proved abortive for want of rescurces!

The first submarine boat was nearly contemporaneous with the first balloon. Its debut was a success. At the very start, the experimenter succeeded in submerging himself in the water, just as he succeeded in rising in the air. Then occurred a period of rest, and for more than a century, submarine like aerial navigation made but insignificant progress. Both are about awakening from their long slumber. Why? It is because the progress of science is putting more and more powerful sources of energy at the disposal of inventors. The whole question is just there.

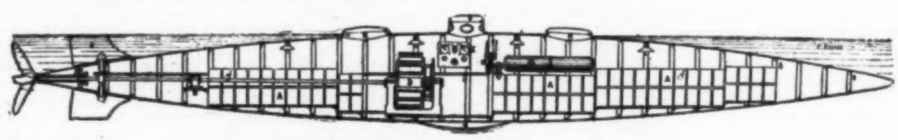
In order to steer a submarine boat, just as in order to steer a balloon, a certain amount of motive force must be concentrated in a certain volume and under a certain weight. Such minimum weight is perfectly calculable. It is that which will permit the balloon to overcome the resistance of the wind. With the submarine boat, the definition is a little more complex, but we shall attempt to give it.

At present, we have no method of seeing more than a few yards ahead of us in water. The submarine navigator is therefore doomed, if not to blindness at least to intense myopia. But this inconvenience, which is now insurmountable, would be very greatly attenuated were it possible for him to rise to the surface and remain there for merely the few moments necessary to get his bearings, and then dive with the agility of a porpoise. Then he would have ample opportunities of escaping the fire of an enemy. But in order to obtain such agility, he would have to have a power of propulsion comparable with that of the porpoise, just as the balloon would have to possess a power comparable with that of the bird in order to resist the wind. Now none of the sources of energy practically exploited



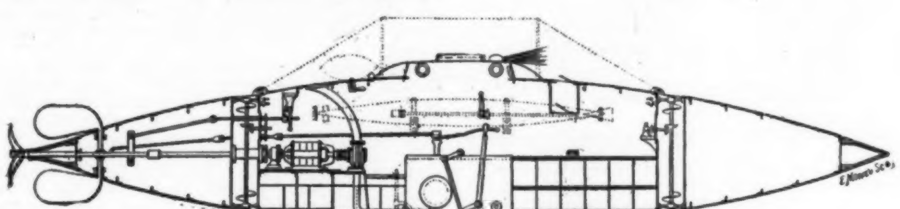
HAIGHT AND WOOD. (1886).

Submarine boat with a float. Length, 81 feet; diameter, 5·75 feet; propulsion by a screw and liquefied carbonic acid motor; submersion through the introduction of water; armed with torpedoes.



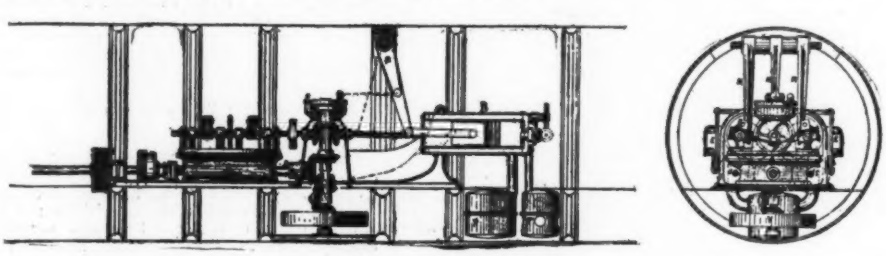
GUSTAVE ZÉDÉ. French (1888).

The "Gymnotus." Length, 56·75 feet; diameter, 6 feet; displacement, 30 tons; propulsion by electricity; submersion through the introduction of water and a horizontal rudder; constructed of steel.



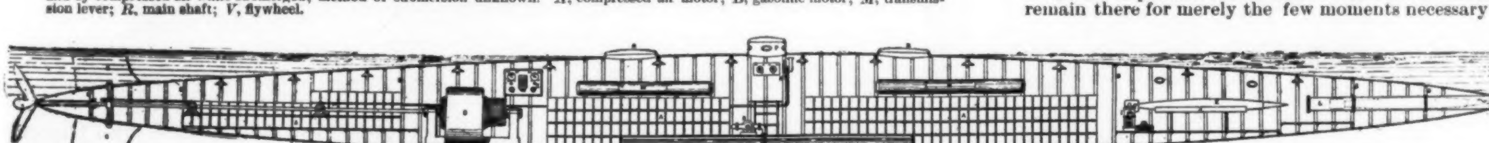
WADDINGTON. English (1886).

Length, 37 feet; diameter, 6 feet; propulsion by electricity; submersion through vertical screws operating in two compartments and also by means of a horizontal rudder; constructed of steel; armed with torpedoes.



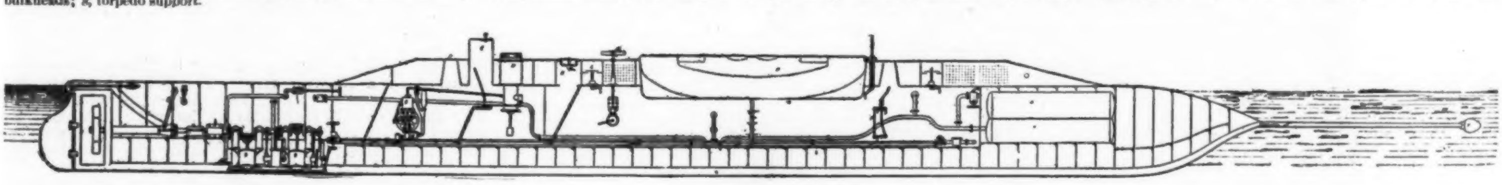
BARON. French (1886).

Project for a submarine boat with mixed propulsion. Length not known; diameter, 10 feet; propulsion by a gasoline motor while afloat and by compressed air while submerged; method of submersion unknown. *A*, compressed air motor; *B*, gasoline motor; *M*, transmission lever; *R*, main shaft; *V*, flywheel.



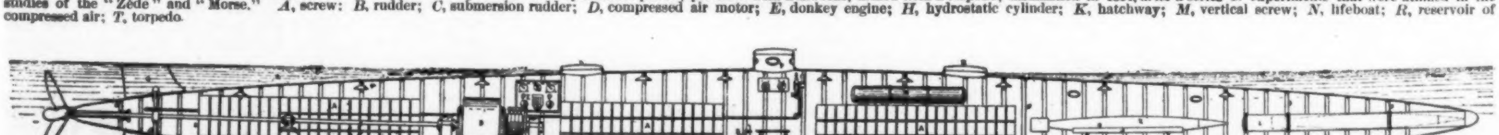
ROMAZZOTTI. French (1896).

The "Morse." Length, 118 feet; diameter, 9 feet; displacement, 146 tons; propulsion by a 350 H. P. electric motor; submersion through the introduction of water and with the aid of a horizontal rudder; constructed of Roma metal. *A*, accumulators; *B*, submersion pump; *C*, submersion reservoir; *D*, electric motor; *F*, conning tower; *G*, steering rudder; *H*, rudder wheel; *K*, torpedo; *L*, torpedo tube; *M*, reservoir of compressed air; *S*, tight bulkheads; *s*, torpedo support.



ADMIRAL BOURGEOIS AND BRUN. French (1863).

The "Plongeur." Length, 146 feet; width, 19·5 feet; height, 11·75 feet; tonnage, 450 tons; propulsion by a screw actuated by an 80 H. P. compressed air engine; submersion through the introduction of water, through a vertical screw actuated by hand, and through a reduction of volume by means of a hydrostatic piston; provided with a lifeboat; armed with a torpedo; dismantled in 1864, after a series of experiments that were utilized in the studies of the "Zédé" and "Morse." *A*, screw; *B*, rudder; *C*, submersion rudder; *D*, compressed air motor; *E*, donkey engine; *H*, hydrostatic cylinder; *K*, hatchway; *M*, vertical screw; *N*, lifeboat; *R*, reservoir of compressed air; *T*, torpedo.



GUSTAVE ZÉDÉ No. 2. French (1892).

Length, 148 feet; diameter, 10·75 feet; displacement, 260 tons; propulsion by a 750 H. P. electric motor; submersion through the introduction of water and the use of a horizontal rudder. *A*, accumulators; *B*, submersion pump; *C*, submersion chamber; *D*, electric motor; *E*, distributing board; *G*, rudder; *H*, rudder wheel; *I*, air compressor; *J*, torpedo support; *K*, torpedo; *L*, torpedo tube; *M*, air reservoir; *P*, conning tower; *R*, hatchway; *S*, tight bulkheads.

THE PROGRESS OF SUBMARINE NAVIGATION

(such as steam, electricity, etc.) furnishes us as yet with motors whose power and flexibility approaches that with which Nature has endowed certain living beings.

Such inferiority of mechanical motors is still great, but is continually diminishing. Every day in the entire world, thousands of human brains are working at that problem of capital interest to humanity, the concentration of energy. Every day some one is inventing a new improvement permitting of the use of steam at a higher pressure, and of storing or producing electricity with a stronger, smaller and lighter apparatus. We are daily approaching the goal, and although, as we have said, and as we repeat, the present submarine boat is as yet very far from being perfect, we have thousands of reasons for working to improve it; but we should be a thousand times in error in making our system of naval defense rest thereupon. To act thus would, in our opinion, be to commit the same imprudence and the same error that we should were we to subordinate the organization of our land army to the use of dirigible balloons.

For the above particulars and the engravings we are indebted to L'Illustration.

THE COSMOSCOPE.

The apparatus to which the name of "cosmoscope" has been applied is, as a matter of fact, a magic lantern into which important improvements have been introduced so as to change it from the simple instrument of amusement that it formerly was, into a true apparatus of instruction. What, from a scientific viewpoint, is most important is, that in its new form it affords a quick method of making researches in cases that do not require a great degree of precision. This is due especially to the fact that, while the use of the ordinary projection apparatus requires the previous acquisition of transparent negatives, which are always costly, the cosmoscope permits of projecting upon a screen opaque and even animate objects. It is possible to obtain projections of photographs, images, writing, plants, insects, etc., which come out in sufficient relief to give valuable information; so that the apparatus is capable of rendering immense services to collectors.

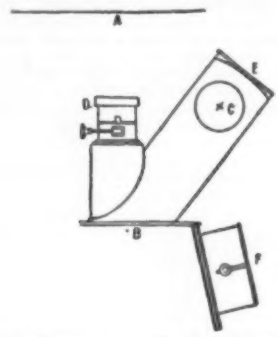


Fig. 1.—DIAGRAM OF THE COSMOSCOPE.

Besides, the enlargement is sufficient to permit of observing details that the eye would have great difficulty in detecting, and the more so in that the luminous source is here more powerful. This is a fact worthy of consideration, since the magnifying glass does not always allow of the recognition of differences of detail, because of the inadequate illumination of the object under examination. Finally, two objects of small dimensions may be compared.

A cosmoscope of ordinary size magnifies an object about twelve times, but there is nothing to prevent a greater enlargement being obtained should necessity require it.

The apparatus consists of two cylindrical parts of unequal sections, the smaller of which enters the other, while the axes of both are in the same plane. The small cylinder is provided with an objective, *D* (Fig. 1), and the large one carries, at right angles with its axis, two combined plano-convex lenses, of which the convex surfaces face each other. Back of this system there is situated a source of light, *C*, which may be either a kerosene or an acetylene lamp. The extremity of the cylinder, behind the lamp, is closed with a concave mirror, *E*, which reflects the rays of the luminous source in the direction of the system of lenses of which we have spoken. The object to be projected is placed against the diaphragm situated at *B*. The focusing of the objective is effected by means of a small rack. When it is desired to project a slide made for an ordinary lantern, we uncover a concave mirror placed at *F*, behind a shutter, which in this case is removed. This mirror sends the rays through the slide.

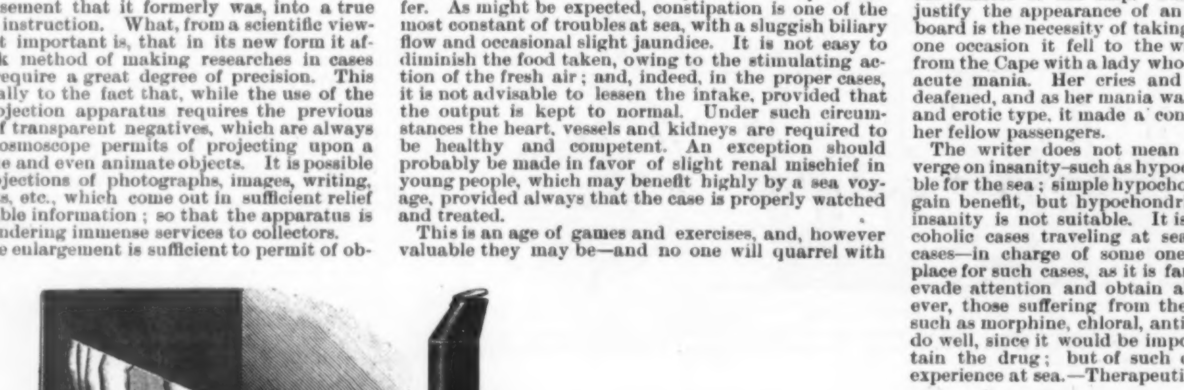


Fig. 2.—THE COSMOSCOPE—A MAGIC LANTERN FOR PROJECTING OPAQUE OBJECTS.

Upon the whole, the cosmoscope is destined to render great services in public lectures, schools, etc., since it requires no special installation and is not very high priced.

For the illustrations and the above particulars we are indebted to La Vie Scientifique.

ON THE THERAPEUTIC USES OF SEA TRAVEL.

An entertaining article with this title is contributed to the Birmingham Medical Review for December, 1898, by S. H. Perry. The writer describes the classes of cases which may be expected to derive benefit from a sea voyage. He does not intend to pass any extensive judgment on this question, but wishes more especially to draw attention to cases which he has seen benefit by this plan of treatment.

The patient most likely to gain definite and permanent good from the sea is one suffering from mental overstrain or from varieties of so-called functional disease (such as functional albuminuria), both ever-increasing classes; secondly, one having only slight organic disease. The essential point is that the patient, however low his sand may have run, must still have good capacity for repair, must have a good potential vitality. Sea-voyaging is but a poor treatment for the later days of phthisis; this seems obvious, yet by the remembrance of it much misery might be saved.

It is well, first of all, to consider the conditions of life to which a patient is subjected on board ship. The essential conditions of ship life are: rest, full feeding, constant fresh air, change of scene and of method of life. To these may be added an absence of all worry if a suitable voyage be chosen.

The case that will benefit by such an environment is fairly evident. We get, in fact, a modified Weir Mitchell treatment (without isolation), combined with an "open air" treatment. Those suffering from brain overwork, convalescents, neurasthenics, and early phthisical cases do admirably on these lines and usually put on flesh rapidly; but, naturally, cardiac and arterial diseases, renal trouble, and plethora are apt to suffer. As might be expected, constipation is one of the most constant of troubles at sea, with a sluggish biliary flow and occasional slight jaundice. It is not easy to diminish the food taken, owing to the stimulating action of the fresh air; and, indeed, in the proper cases, it is not advisable to lessen the intake, provided that the output is kept to normal. Under such circumstances the heart, vessels and kidneys are required to be healthy and competent. An exception should probably be made in favor of slight renal mischief in young people, which may benefit highly by a sea voyage, provided always that the case is properly watched and treated.

This is an age of games and exercises, and, however valuable they may be—and no one will quarrel with this spirit of the age—it must be admitted that there is also now a marked tendency to overdo exercise. Not infrequently the overworked town-dweller, on taking a holiday, attempts to get himself into condition, as he puts it, by completely overworking a system which requires rest and food before it could be capable of physical exercise. This type does excellently well at sea, for he cannot work and he is sure to eat, even to overeat. Tubercular cases are not infrequently of this type, being often of active mind and disposition, and in possession of a sort of spurious energy. Early tubercular cases certainly do very well at sea, yet it is of great importance that they should be watched and not allowed to do foolish and harmful things. The writer has on several occasions on board ship seen a phthisical patient announce his disease with a serious relapse, which might easily have been prevented had any one known of his condition. Hemoptysis was in one case brought on by the patient taking part with the other passengers in some athletic exercises, and in another case by the patient joining in a game of cricket. Moreover, these early tubercular cases, being practically in good health and mostly young, are apt to run wild at the different ports of call and thus help to nullify any previous gain. It is conceded now that cold does not do any harm to phthisical cases, while the constant fresh air, sunshine, and equable temperature of marine climates are of the greatest advantage. To this should be added that catarrh is scarcely known at sea unless previously contracted on land.

It is generally held that organic renal disease contraindicates sea travel. The so-called functional albuminuria is, on the other hand, a type of case likely to be cured by a sea voyage, provided certain precautions are taken, such as the keeping up of a proper action of the bowels and the prevention of excessive meat consumption. The writer is under the impression that cases of intermittent albuminuria, in young people with unstable circulation and great variability of pulse tension (as described by Broadbent), are likely to be much improved by sea travel; but he notes that Broadbent considers that the best treatment is an active outdoor life on land, and writes: "When a long voyage has been ordered I have known the albuminuria to persist while at sea and cease with active exercise on shore." The writer himself, in two cases, has seen excellent results from a sea voyage. One of these patients he knows to be in good health, having no albuminuria, some eight years after he went the round-world voyage. A case of slight postscarlatinal nephritis did very well on a voyage to Japan and back. The patient (a boy aged fifteen years) was allowed to eat fairly freely of meat, but was advised to chiefly eat fowl and fish. He also drank, in the hot weather, one or two tumblers of water between meals, for the purpose of diluting the urine, which is very concentrated owing to the excessive loss of fluid by sweating. Provided that the urine is kept well diluted, the sweating might be expected to be useful. In this case casts and albumen had disappeared from the urine at the end of three months, and three months later, on his return, the boy appeared to be quite sound.

With regard to female patients, the writer states that it should be borne in mind that they are, as a rule, not suitable for sea travel, being much more inconvenienced than men by the variety of small discomforts which obtain on board ship.

In conclusion, a word with reference to mental patients. Persons who are definitely insane, or liable to attacks of definite insanity, ought not to be sent to sea under any circumstances, unless in a private vessel. Mental patients are a nuisance to other passengers, and an unfair responsibility on the shoulders of the officers of the ship. The only thing that can justify the appearance of an insane person on shipboard is the necessity of taking him to his home. On one occasion it fell to the writer's lot to travel home from the Cape with a lady who suffered from recurrent acute mania. Her cries and language could not be deafened, and as her mania was of the foul language and erotic type, it made a considerable impression on her fellow passengers.

The writer does not mean that cases which may verge on insanity—such as hypochondriasis—are unsuitable for the sea; simple hypochondriasis is very likely to gain benefit, but hypochondriasis forming a part of insanity is not suitable. It is not unusual to find alcoholic cases traveling at sea, usually—like mental cases—in charge of some one. A ship is not a good place for such cases, as it is far too easy for them to evade attention and obtain alcohol. Probably, however, those suffering from the effects of other drugs, such as morphine, chloral, antipyrin and others, would do well, since it would be impossible for them to obtain the drug; but of such cases the writer has no experience at sea.—Therapeutic Gazette.

RAPID BLUEPRINTING PROCESSES.

By Albert E. Guy.

After much experimenting on the rapid blueprint process, I have found that the following method gives the best results: Sensitizing solution—Oxalate of iron and ammonia, 1; water (as pure as possible), 10. The iron salt dissolves in a few minutes. If a solution is prepared long in advance, it must be kept in a very dark place, in which case it can be preserved indefinitely. I would advise buying the best quality, and to make [a fresh solution whenever required. The solution can be applied to the paper by means of a wide and soft brush, or the paper may be floated upon the solution in a shallow tray. The floating should last about one minute. I find brushing most convenient. The brush should be lightly loaded with liquid and be drawn evenly on the paper without passing twice at the same place. Any careful man can acquire the "hang" in five minutes.

The sensitizing and drying of the paper must of course be done in a dark place. The drying after brushing requires a few minutes only.

If this paper is exposed under a tracing to the sunlight, an exposure of 30 seconds only is required. On a rainy day, the window being closed, I made a very fine print in 4½ minutes by holding the printing frame close to the window.

The sensitized paper has a yellow coloration, and where the light has acted the yellow color has become bleached, and the image stands as a positive in yellow lines on white ground. Still, as the lines are very faint, one must acquire a certain amount of experience to determine accurately at sight the necessary time of exposure. After making a dozen or two small prints in different kinds of weather, the operator can generally guess at the proper time, at least that has been my experience.

Develop the print as soon as it leaves the frame. Immerse in the following solution for two or three minutes, wash in water for ten minutes, hang up to dry. The image is in white lines on a blue ground.

Developing Solution—Ferricyanide of potassium, 1; water, 30.

These proportions need not be strictly adhered to. A weak solution is all that is necessary. Red prussiate does not dissolve readily in water. It is advisable to make in advance a solution 1 to 10 in a large bottle and keep it ready for use. Dilute it as required. This solution keeps very well. Most people object to developing in a separate solution, but this process is so

simple that anyone who tries it with a will, will be satisfied.

A "one-solution process" can be operated with the following sensitizer: Oxalate of iron and ammonia, 1; water, 10. Make one solution and mix, when ready to use, with an equal part of this other: Ferricyanide of potassium, 1; water, 10. Sensitize paper as before with a brush or by floating, and develop by simply washing in water like ordinary blue print. The exposure required is the same as in the previous case, with the advantage that the progress of the printing can be watched. As soon as the light acts, the paper turns blue. When this color is sufficiently intense, remove the print from the frame and wash. The print after washing retains the same color as before.

It is impossible to make this solution keep, and the paper prepared in advance keeps only one or two days in good printing condition. The lines are not very white.—American Machinist.

THE "HOUSE IN THE WOODS" AT THE HAGUE.

It was only in the past year that the solemn crowning of the youthful Queen of the Netherlands directed the gaze of the whole world upon this prosperous land, and now the attention of everyone is again drawn to the beautiful residence city of The Hague, which has been chosen by Czar Nicholas II. as the place for the realization of his beautiful and sublime peace idea. Queen Wilhelmina, upon being asked whether the conference might be held in The Hague, joyfully replied in the affirmative and did not hesitate to appoint a place worthy of so brilliant a gathering and worthy before all else of the high purpose for which this assembly was convened. Her choice fell upon the "House in the Woods" (Huisten Bosch), one of the handsomest and most finely decorated of her residences, situated near the city in the midst of an extensive wood which King William I. transformed into a park.

Originally designed by Prince Frederick Henry as a summer villa for his consort, Amelia von Sohns, the "Orange-hall" was in the course of construction when the sudden death of the Prince (March 14, 1647) caused a change in the purpose for which it was intended. Amelia von Sohns, in deep grief for her dearly beloved consort, resolved that the unfinished building should be transformed into a mausoleum "for the perpetuating of his fame and her pain." The Orange-hall should serve, however, not only as a memorial of the person of Frederick Henry as victor and conqueror of cities. It should also bring into view the fact that by his victories the Prince prepared and made possible a long-wished for peace, a peace that cost eighty years of bloody warfare. The conquering hero must stand out and be immortalized first of all as the author of peace, in which character his people remember him, although he himself did not live to see the final peace signed, and in which character he still lives on to-day in the memory of the Netherlanders.

Built according to the plans approved by Frederick Henry, the palace consists principally of an octagonal hall 50 feet in diameter, surrounded by a number of smaller rooms.

In 1748, Prince William IV. enlarged the villa through the addition of two side wings, and in some of the rooms of this addition the Peace Conference holds its meetings. Napoleon I. changed the building into a state prison, but the first King of the Netherlands, William I., restored to it its former splendor.

Besides the Orange-hall, the palace contains a Chinese room filled with bric-a-brac presented by the East India Company and papered with curious wall paper representing Chinese landscapes; a Japanese room containing many costly presents from the Emperor of Japan; and an admirably decorated little room with a frieze painted in imitation of bass reliefs. This was the work of Jacob de Witt, a painter who acquired renown in the beginning of the last century; and so skillful a piece of painting is it, that it entirely deceives the eye of the ordinary observer.

Amelia von Sohns, shortly after her husband's death, had the main hall capped with a dome, the ceiling of which is 60 feet above the floor below. She personally supervised the minutest details in the building and decoration of this memorial to her renowned consort and it is not unlikely that in so doing she followed the example of Marie de Medici, who, thirty years before, after the death of her husband, Henry IV., of France, converted the Luxembourg Palace built by her into an ancestral Pantheon, through the master hand of Rubens. Amelia von Sohns did not have at her disposal the brush of a Rubens or a Vandyke; both were already dead. But, nevertheless, there were men at hand to whom the art of these great painters had descended, who were chosen instead by Amelia to carry out her plans. Among them, in the first rank, was Rubens' well known scholar Jordaens, and Van Tulden, who, with his great master, had worked on the gallery of the Luxembourg Palace, and also Peter Zoutman of Haarlem. Besides these three Amelia employed other no less distinguished artists, such as Gerard Houthorst, Cesar von Everdingen, Solomon de Vray, Peter de Grebber, Jan Lievens, Cornelius Brisé, and the Flemish painter Thomas Willeboots.

To-day, after almost two hundred and fifty years, the work of this artist stands before us in such a wonderful vividness of coloring as to have the appearance of a freshly-painted canvas. In spite of some traces of exaggerated fancy, all of which are for allegorical purposes—and this was a well-known failing of the time—one finds them easy of understanding. Frederick Henry's life, with all the good fortune and triumphs which had befallen him, is spread out before us from the day of his birth onward to that last allegory from the hand of Grebber which shows the Stadtholder triumphing over Death.

As already stated above, Amelia von Sohns honored Frederick Henry before all things else as the author of peace, and so we come upon representations of the peace almost step by step as we advance through this hall, till finally, in decisive, beautiful realization, at the little door through which the members of the Peace Conference pass into the Orange-hall, come Power and Wisdom opening the doors for the hovering Genius of Peace, with the palm and olive branches in his hands.

Thus the Orange-hall stands as a peace temple, as stated in the words of the beautiful legend upon it. One who does not know its story and who enters it quite unprepared, will soon know its significance, and be unable to draw himself away from the charm that goes forth from the beautiful paintings.

Young Queen Wilhelmina cannot more beautifully symbolize her heart's wish that the Peace Conference may result in the prosperity of the nations than through her choice of this place for the earnest discussion which millions are now anxiously awaiting.

THE "HOUSE IN THE WOODS."

We are indebted to Ueber Land und Meer for a part of the above description, and to the Gartenlaube for the illustration.

ENAMELING AS AN INDUSTRY.

By Josef Vollkommer, Pittsburg, Pa.

By way of introduction I desire to state that it is not my intention in this paper to exhaust the above subject, but merely to give a general sketch of an industry which, though comparatively of recent origin, has developed at such gigantic strides, representing in this country alone an investment of more than $50,000,000. Yet, despite this fact, its details are little known outside of those actively engaged in it, since most manufacturers use their own processes, which if not protected by patents are considered trade secrets.

In defining enamels we find them to be a coat of glass, transparent or opaque, applied to metals or ceramic products. Confining ourselves to the first mentioned, we ascertain that its history, like that of glass, is very old. The first specimen of the enameler's art is to my knowledge the highly ornamental breast plate (pectorale) of Rameses II., King of Egypt (about 1400 B. C.), at present in the Louvre, at Paris.

Enameling may be subdivided into several widely differing branches. We have the jeweler and artist enamels, used for decorating precious metals, or for producing vitrified paintings on metallic surfaces, then such for copper and iron, the latter of which are less intended for decorative effects than as preservatives against chemical and mechanical influences. Like glass, all enamels consist mainly of silica and alkalies. But few metallic oxides enter directly into their manufacture, as for instance the several oxides of lead (especially minium, Pb_3O_4), which form the silicates of lead or leadglass; as a rule they only serve to impart color and opaqueness. Borax is another important element of composition, since it serves occasionally as a substitute for silica, oftener, however, to regulate the fusibility of the enamels. The fact that borax easily dissolves most metallic oxides, producing very intensely colored glasses, makes this chemical indispensable to the enameler.

The use for which ware is intended governs the composition of enamels and their smelting points. Those serving only for decorative purposes (as most jeweler and artist enamels) require in the first place a brilliant color and high gloss at a low smelting temperature. Their resistance against chemical action is of minor importance, also the consideration whether they contain elements detrimental to health, such as, for instance, arsenic or oxides of lead. Enamels used for industrial purposes, on the contrary, must in the first place resist successfully chemical and atmospheric influences, hence require higher smelting temperature and differ, of course, greatly from the first mentioned, which are mostly silicates of lead.

Another item to be considered by the manufacturer is cost of producing. While it is of minor importance when only small quantities are consumed, as for artistic work, it is one of the gravest problems to solve for the large manufacturer of enameled iron articles, where thousands of tons are consumed each year.

Generally we find that the greater is the percentage of silica to the other elements in any enamel the more difficult is its fusibility, the greater its hardness and durability. Thus, were silica alone fusible under ordinary conditions, it would be the ideal enamel, resisting nearly all chemicals and change of temperature, therefore enamels containing apart from silica only small amounts of alkalies are among the most durable and serviceable.

The most important raw materials used in the manufacture of enamels are silica and several alkalies. Silica is mostly used in the form of pulverized quartz. Flint, while of the same chemical composition (SiO_2) as quartz, ought not to be substituted for the latter, since its action upon alkalies appears to be slightly different.

The alkalies we require can be used in various forms, since they all combine with the silica, forming a glass. Thus, sodium and potassium products are used. However, the sodium compounds are preferable, since they form silicates at a much lower temperature than the first mentioned, although giving not quite as durable an enamel. The most required potassium products are carbonate of potassium and saltpeter. Both salts are easily soluble, absorbing moisture freely; both are of a white color; the former is strongly alkaline. Among the sodium compounds used are enamel soda (sodic carbonate), sodic sulphate or Glauber salt and common salt. Other mineral and chemical products entering into the manufacture of enamels are feldspar, fluorspar, lime or calcium oxide, carbonate of magnesia, sulphate of magnesia, sal ammoniac, several kinds of clays, and last but not least the various metallic oxides. However, they all form only a small part of the enameler's stock of raw materials.

The iron enamels, according to their application, can be divided in two classes—ground enamels, requiring a high smelting temperature and the more easily fused outside enamels. The first coat, or "ground," consists mainly of quartz, borax and feldspar. By adding carbonate of magnesia or clay, the smelting point of the mixture may be raised, until, if applied to the metal, the enamel will not smelt entirely, but, as it were, only sinter or bake to it. Since the second or outer coats are supposed to form a perfectly smooth glossy porcelain-like surface, their smelting point is considerably lower than that of the "ground" enamel. Otherwise the dark ground might mix and blend with the differently colored surface.

Preparation of the Metal for Enameling.—The durability of enameled articles depends in a great measure upon the proper treatment of the metal's surface. The best enamel will chip or scale from iron which was not properly prepared. Sheet metal, especially stamped ware, after having been annealed in special furnaces, is subjected to a pickling process in diluted sulphuric or muriatic acid. After an immersion of several hours and a thorough scrubbing the last traces of acid are removed by dipping the articles in boiling soda solution. They are now ready for the application of the enamel. Cast iron for our purpose ought to contain only a low percentage of carbon. Its surface should be bright and all scales or traces of facing carefully removed. After slightly pickling such castings and cleaning them with boiling water, the ground coat may be applied.

For smelting enamel, tank or crucible furnaces are used. The tank furnaces are of various construction, for continuous and intermittent use, and resemble in several features our open hearth steel furnaces. The fire gases, after enveloping the bottom and sides of the tank, finally pass over the latter and thus come in contact with the smelting enamel before reaching the outlets to the chimney. Crucibles, as a rule, are arranged in groups or batteries of 10 to 12, in such a way that each one can be used separately or all at once, according to the nature of the work. Special valves regulate the consumption and distribution of the gas. Both kinds of furnaces have their special merits and disadvantages. Tank furnaces commend themselves where large quantities of an ordinary enamel are required, which is not easily affected by the reducing influences of fire gases, while crucibles, being protected by covers against the direct flame, are used with advantage to obtain better enamels, especially such which might suffer through direct contact with the flame, as for instance the silicates of lead. How important the difference between oxidizing and reducing heat is, will be seen from the fact that an enamel containing oxide of copper would turn green only in oxidizing flames, while reduction would turn the cupric oxide (CuO) into cuprous oxide (Cu_2O), and in place of a green enamel, we should have such of a reddish or gray color. Other oxides changing in a similar way are those of iron, manganese, chrome, and silver.

The several raw materials are used in pulverized form and ought to be thoroughly mixed before emptying into the smelting furnace. Frequently the molten enamel is granulated by running it from the furnace directly into vessels with water, which operation lessens considerably the mill work, but also results in an inferior quality of enamel, which in this way loses valuable elements through the formation of waterglass.

The enamel mills do not differ materially from other devices for pulverizing mineral products. However, the material should not come in direct contact with any metal surface, wherefore crushers with iron jaws are objectionable. Even small particles of iron will discolor otherwise perfectly white enamel. The porcelain lined pulverizing mills are considered among the best for our purpose. They consist of a large hollow cylinder, lined on its inside with unglazed porcelain, and swinging around a horizontal axis. The grinding is produced by the sliding and rolling inside this cylinder of a great number of spherical flint pebbles, mixed

with the coarse enamel, while the cylinder is rotating. The material is usually delivered to an automatic feed and from there conveyed to the inside of the cylinder, to be ground (either wet or dry) through the action of the pebbles. When the enamel is sufficiently fine and after having traveled through the entire length of the cylinder, it is discharged through a spout into large receptacles. These cylinder mills, aside from their economic operation, produce no dust and prevent absolutely contamination during the process of grinding.

The enamel is applied wet or dry. In the latter case water is added to the mill charge, frequently also Epsom salt, carbonate of magnesia, clay, etc. Such metallic oxides should now, too, be added which are very susceptible to the oxidizing or reducing effects of fire gases.

For sheet metal ware almost exclusively wet enamels are used. They ought to contain sufficient water to give them the consistency of thick cream or sirup. As a rule the enameling is done yet by hand, although there exist several excellent devices to do this work mechanically. The first operation consists in scrubbing the vessel thoroughly with brush and water so that its entire surface is moist. Next the dipper, with three-armed, tongue-like springs, takes hold of it and immerses thoroughly in a large vessel with enamel, or pours the latter over it. After assuring an equal distribution through swinging and shaking the vessel it is handed to another person, who with steel needles and scraper removes all superfluous enamel, especially from the seams and rims, to prevent the formation of unsightly lumps and blisters.

The ware thus finished is conveyed to the drying room to evaporate all moisture. The unburned enamel being very brittle, those articles require careful handling, and are usually carried on iron grates, with sharp points, so as to injure the surface as little as possible.

For burning the ware, muffle furnaces are used. They consist of a retort or muffle of fire clay, so inserted into the furnace that the fire gases envelop its entire outside, but do not come in direct contact with its interior, only heating the muffle to a very high temperature, the smelting point of enamel. Heavy, well balanced cast iron doors, lined on the inside with fire clay, admit the ware, which is run in and out on grates by mechanical devices resting on peculiar carriages (forks). This operation (changing the grates) ought to be done in the shortest possible time, in order to keep a uniform heat in the furnace. A small hole in the furnace door enables the burner to observe the interior of the muffle, and so soon as the ware assumes a bright red color and high gloss, he changes the grate for another containing unburned ware. The second and following coats of enamel are applied and burned in the same way. These latter coats ought to be thin, but very opaque, and more easily fluxible than the ground. After their last fire, the ware, still red hot, is pressed into shape by various devices, so as to assume its originally intended shape.

Enamel, like glass, gains greatly in toughness and elasticity if permitted to cool slowly, for which purpose a peculiar tunnel-like furnace (up to 60 feet long) is used. Its temperature is the highest at the point where the ware enters. The latter travels automatically on small cars on a slight incline toward the cooler outlet, and, after assorting, is ready for the market.

The several kinds of enameled sheet metal ware are all subject to the same general treatment, but differ, of course, in the composition and application of enamel, etc. For instance, the so-called granite ware contains only one coat of enamel, which makes it very cheap to produce. Its darker spots (mottling) is simply the action of certain metallic salts (sulphates of iron, cobalt or nickel), which form part of the composition of the enamel upon the metal. Other cheap processes consist in mixing variously colored enamels in such a way as to produce a dotted surface. The marble effects are produced mechanically. The decoration is done much in the same manner as China ware, and decalcomania processes are used where designs repeat. The manufacture of enameled advertising signs has developed into a special industry. The preparation of the metal and the composition of the various enamels is the same as described before. However, greater care must be taken in spreading the enamels equally over the often very large surfaces, for which purpose frequently large soft brushes are used in preference to dipping or immersing, if the enamel is not applied mechanically by machines. The lettering (raised or sunk) is done by means of paper or metallic stencils, which are put over the sign, containing the last, unburned coat of enamel, and then rubbed out by brushes. After careful retouching the sign is burned in such a way as not to leave any marks on the surface.

To cast iron the ground coat or slush is applied wet, and the remaining enamel, wet or dry, according to size and use of the articles. The dry process consists in applying the pulverized enamel either by hand or mechanically to the metallic surface, which has previously been treated to assure a good adhesion. The casting is then burned in a muffle furnace, and this process repeated until a perfectly smooth and uniform surface is obtained. Cast iron may be enameled like the sheet metals in various colors and decorated in a similar manner. Very pretty effects are obtained with the so-called majolica enamels, called so from their close resemblance to glazed pottery or majolica ware. These enamels can be prepared in almost any color and are applied by sifting over the red hot metal, not necessitating a special muffle furnace or second fire. This is a short outline of an industry which with each year gains in importance. The fact that only lately a $30,000,000 syndicate has been organized to control the granite enameled ware will give a small idea of the capital invested in it, and of its magnitude.—The Iron Age.

A rat's tail is a wonderful thing. The great naturalist Cuvier says that there are more muscles in this curious appendage than are to be found in that part of the human anatomy which is most admired for its ingenious structure—namely, the hand. To the rat, in fact, its tail serves as a sort of hand, by means of which the animal is enabled to crawl along narrow ledges or other difficult passages, using it to balance with or to gain a hold. It is prehensile, like the tails of some monkeys. By means of it the little beast can jump up heights otherwise inaccessible, employing it as a projectile spring.

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